

APPLICATION OF GAMIFICATION ELEMENTS IN NURSING ADMINISTRATION COURSE AND ITS EFFECT ON NURSING STUDENTS' KNOWLEDGE AND MANAGERIAL SKILLS

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Abstract

Background: Gamification emerges as an effective teaching approach as it makes the activities perceived as boring and difficult for the learner fun, provides motivation, and makes the learning process more attractive. **Aim of the study:** To assess the effect of application of gamification elements in nursing administration course on nursing students' knowledge and managerial skills. **Subjects and methods:** This one-group quasi-experimental study was conducted at the Technical Nursing Institute in Abbasseya Fevers Hospital in Cairo, Egypt included all available nursing students enrolled at the fifth year during the time of the study. Their total number was 70. Data collection tools consisted of a knowledge questionnaire and an observation checklist for managerial skills. **Results:** Students' age ranged between 19 and 22 years, 45.7% had previous experience with gamification. Satisfactory knowledge increased from 14.3% pre-intervention, to 100.0% at both post and follow-up phases ($p < 0.001$). Adequate managerial skills rose from 0.0% pre-intervention to 80.0% and 82.9% at post and follow-up phases. The multivariate analysis identified the study intervention as a significant independent predictor of the knowledge and managerial skills scores. **Conclusion and recommendations:** The utilization of gamification elements is effective in improving nursing students' knowledge and skills' managerial skills related to the nursing administration. Using gamification elements should be included in the educational curriculum of nursing institutes. Further research is proposed to compare different types of gamified learning interventions on nursing students' psychomotor skills acquisition.

Keywords: Gamification Elements, Nursing Students, Knowledge, Managerial Skills, Nursing Administration.

INTRODUCTION

Recent decades have been witnessing dramatic development of pedagogical approaches since they can provide enough freedom for students who may feel convenient to acquire knowledge assisted with teachers and peers through online technology-enhanced platforms [1]. Thus, the traditional model of teaching, based on a unique approach for all cases, is no longer appropriate to meet the growing needs of students, since the learning process does not follow this linear method [2].

Gamification emerges as an effective teaching approach as it makes the activities perceived as boring and difficult for the learner fun, provides motivation, and makes the learning process more attractive and active [3]. It refers to the application of game concepts to the learning process, such as a narrative and progress tracking mechanisms, to make it more enjoyable and engaging [4]. Educational games could potentially provide high-quality, inexpensive, flexible, portable, and relaxing educational services, which could increase interactions between learning materials, students, and teachers [5].

Gamification aims to apply specific aspects of games/gaming to tasks and events to produce desired effects [6]. Gaming elements refer to a set of rules that dictate the outcome of interactions within gamified systems [7]. The most common game elements that were employed in the different settings included points, leaderboards, feedback, unlockable content, levels, badges, avatars, gift cards, customization, and challenges [8]. The game elements used in educational programs are very different at different levels, but some elements are used more than others. The majority of the used game elements are Point, Leaderboard, Badge, Level, Feedback, Progress bar, Challenge and Avatar [9].

The term gamification acts as a broad umbrella for the use of video game components in order to improve the experience and increase users' participation in environments and contexts that are not related to the game [9]. Gamification is combination of game elements as leaderboards, points, badges, levels, rewards, and virtual currencies to create game mechanics like missions or tasks to reach a defined goal [10]. Researchers predicted that by the end of 2015, more than 40% of the world's top 1,000 organizations will benefit from gamification components in terms of customer orientation and product quality improvement and in the near future, there will be significant progress in the field of internalization of internal processes as well as external interactions, i.e., attracting more users and customers [11].

There is a trend among educators in various health professions to use gamification to enhance students' learning. This is particularly important in the nursing profession, as competency is related to one's ability to proficiently apply knowledge in the health setting and positively influence or improve patient outcomes [12]. Educators may now attach the advancements in digital technology and apply strategies to empower the learning process. One such strategy is gamification; gamification can be defined as the application of gaming elements to a non-game setting [8]. Gamification was introduced in the last decade and has focused on many different fields, including education [13].

Research has been carried out to evaluate the effectiveness of gamification applications in education on students' learning outcomes. However, contradicting results, implementation in different educational levels, the lack of specific assessment tools, the ad hoc use of gaming elements, and the general reports from scholars that more studies are required in this field reveal a gap in the literature [14]. Moreover, the practical use of gamification in education depends on the quality of evidence of its effectiveness and also on the support evidenced by the methodological quality of the studies that address this

theme [15]. Thus, future investigations focusing on more robust, theory-driven methods should be encouraged [16].

Significance of the Study

From the researcher's experience as a nursing clinical instructor at technical nursing institute, it was noticed that some of the nursing students had the feeling that nursing administration is the least interesting and the most difficult subject in the curriculum. They were more interested in other nursing subjects they misbelieved they would mostly use immediately after graduation. The researcher hopes that the application of gamification elements in the teaching of the nursing administration course will have a positive effect through stimulating students' thinking, fostering their acquisition of knowledge and mastering skills.

Aim of the Study

This study aim was to assess the effect of application of gamification elements in nursing administration course on nursing students' knowledge and managerial skills. It was hypothesized that the application of gamification elements will have a positive effect on nursing students' nursing administration course knowledge and managerial skills.

SUBJECTS AND METHODS

Research design and settings: this one-group quasi-experimental design with pre-post-and follow-up assessments was conducted at the Technical Nursing Institute in Abbasseya Fevers Hospital in Cairo, Egypt, affiliated to the Ministry of Health and population.

Subjects: these consisted of all available 70 students enrolled at the fifth year during the academic year 2021-2022. This sample size was large enough to demonstrate an improvement in students' knowledge and skills with a moderate effect size (0.35) at 95% percent level of confidence and 80% study power using the G*Power software program, and accounting for an expected dropout rate of about 10%.

Data collection tools: Data collection tools consisted of a knowledge questionnaire and an observation checklist for managerial skills.

- **Knowledge questionnaire:** This was developed by the researcher based on **Marquis and Huston** [17] and **Adam** [18]. Its aim was to assess nursing students' knowledge of the scheduled topics of the course of nursing administration. It had a part for student's personal characteristics as age, marital status, and hobbies, and a main knowledge part. This consisted of 40 questions (24 multiple-choice questions (MCQs), and 16 True/False categorized into eight dimensions covering the nursing administration course's scheduled topics: management process, planning, time management, organizing, nursing care delivery model, directing, supervising and leadership. Each dimension was covered by 3 MCQs and 2 True/False questions. For scoring, each correct answer

was scored one and the incorrect, zero. For each of the eight dimensions of knowledge and for the total questionnaire, the scores of the items were summed up and converted into percentage scores. Knowledge was considered satisfactory if the percent score was 60% or more and unsatisfactory if less than 60%.

- *Observation checklist:* this was developed by the researcher based on **Marquis and Huston** [17] and **Adam** [18].to assess student's managerial skills taught in the above-mentioned topics of the nursing administration course. It had 71 items in addition to the identification data as the student's code number and the date and time of observation. The 71 items were categorized into three dimensions: Planning (2 subscales with 21 items), Organizing skills (2 subscales with 21 items), and Directing skills (3 subscales with 30 items). For scoring, each item observed to be "done" was scored one and the "not-done" scored zero. The average of the three trials observed was calculated and rounded-up to zero or one score. For each skill and dimension and for the total checklist, the scores of the items were summed-up and the total divided by the number of the items and converted into percentage scores. The student's managerial skills were considered adequate if the percent score was 60% or more and inadequate if less than 60%.

Tools' validity and reliability: the preliminary forms of the tools were submitted to seven experts in nursing administration and from the Faculty of Education at the Arab Academy for Science, Technology and Maritime Transport for face and content validation. Modifications, mostly in the form of re-wording certain items, were done based on their feedback. The reliability was high (Cronbach's Alpha coefficient 0.887) for the observation checklist.

Pilot Study: a pilot study was conducted on seven nursing students representing 10% of the main study sample to test the clarity of language, and the practicability and applicability of the data collection tools. It also helped detect any obstacles or problems that might be encountered during the process of data collection. Since no modification was made in the tools, these students were included in the main study sample.

Fieldwork: the study was carried out through five phases, namely preliminary, planning, implementation, post-evaluation, and follow-up evaluation.

Preliminary phase: before data collection, an official approval to conduct the study was obtained through a letter addressed from the Dean of the Faculty of Nursing, Ain Shams University to the Director of the Nursing Institute. Then, the researcher met with the Director of Institute to explain the study maneuvers, and to get an agreement on the proposed teaching methods to be applied in the nursing administration course.

Planning phase: the researcher started the preparation of the action plan for applying gamification elements in the nursing administration course after reviewing related literature, articles, internet search, and textbooks. It also involved review of classroom gamification tools as Kahoot mobile application, in addition to the curriculum of the

nursing administration course. The action plan was validated by a jury consisting of two experts specialized in gamification applications.

Implementation phase: this consisted of 17 hours divided into nine teaching sessions. The first session was an introductory session and lasted for one hour. The duration of each of the remaining eight sessions was two hours. Gamification teaching method was used to applied gamification elements such as earning “virtual points” for completing tasks, playing educational games to learn academic skills, competing with peers on a leaderboard towards a goal by using interactive teaching, creative thinking, group work activities, group discussion, managerial skills sessions, case studies, role play, and brainstorming. In addition, different instructional media were used such as Kahoot application, internet, social media, videotapes, and data show. A handout including the administration book which is standardized at all Technical Health Institutes Nationwide [18]. Different gamification elements were applied in every session. Badges were used as a visual representation of achievements that can be earned. Leaderboards were used though an electronic board (Kahoot application) to display the ranking of students in a competitive learning situation. The levels-based system was used to rank individual student’s progress in stages based on the difficulties, challenges, or questions that need to be completed in order to get to the next stage. Other gamification elements, such as rewards, progress bar, challenges, feedback, and avatar, were used either alone or along with other gamification elements mentioned above.

Post-program evaluation phase: the researcher evaluated the effect of the application of gamification elements in nursing administration course on nursing students' learning outcomes immediately after application of the program. The tools were sent to students in google forms and they were given suitable time to fill them.

Follow-up evaluation phase: Data collection was repeated three months after post intervention using the same data collection tools and processes as in post-program evaluation phase.

Administrative design and Ethical considerations: Official approval was obtained from Director of Technical Nursing Institute of Fevers Hospital using official channels. An approval of the research protocol was obtained from the scientific Research Ethics Committee of the Faculty of Nursing, Ain Shams University. The aim, purpose, benefits of the study, and the impact of this study on the students were explained to the Director of the Institute and to students to get their agreement. In addition, the researcher got an oral consent from each nursing student. They were reassured about maintaining their anonymity and the confidentiality of any collected data. They were also informed that they were allowed to choose to participate or not in the study and that they had the right to withdraw from the study at any time.

Statistical analysis: Data entry and statistical analysis were done using SPSS 20.0 statistical software package. Pearson correlation analysis was used for assessment of the inter-relationships among quantitative variables, and Spearman rank correlation for

ranked ones. To identify the independent predictors of the knowledge and managerial skills scores, multiple linear regression analysis was used and analysis of variance for the full regression models was done. Statistical significance was considered at p -value <0.05 .

RESULTS

The study sample consisted of 70 nursing students whose age ranged between 19 and 22 years, median 20.0 years as presented in Table 1. The majority were unmarried (85.7%) and had hobbies (91.4%). The most commonly reported hobby was reading and writing (45.7%). Slightly less than half of them had previous experience with gamification (45.7%).

Table 2 demonstrates generally low percentages of nursing students having satisfactory knowledge at the pre-intervention phase with percentages ranging between 19.2% for the area of supervising to 64.3% for the area of management process. Statistically significant improvements were revealed at the post-intervention phase ($p < 0.001$), reaching 100.0% in four of the eight knowledge areas. The improvements were maintained at the follow-up phase of the intervention ($p < 0.001$) although with some minimal declines. Only 14.3% of the students had total satisfactory knowledge at the pre-intervention phase. This increased to 100.0% at both post and follow-up phases, with statistically significant differences ($p < 0.001$).

Table 3 indicates that none of the nursing students had adequate managerial skills of the time management skills (to-do-list and time log, and total) at the pre-intervention phase. The percentages of adequate managerial skills significantly improved ($p < 0.001$) at the post-intervention phase (80.0%, and at the follow-up phase of the intervention (81.4%). Moreover, none (0.0%) of them had adequate managerial skills of the two areas of organizing skills and its total at the pre-intervention phase. At the post-intervention phase, there were statistically significant improvements in both areas and the total ($p < 0.001$), with percentage reaching 80.0%. These improvements continued through the follow-up phase of the intervention with no declines. The table also shows that none (0.0%) of the students had adequate managerial skills in any of the three areas of directing skills or its total at the pre-intervention phase. At the post-intervention phase, there were statistically significant improvements in all three areas ($p < 0.001$), with adequate managerial skills reaching 80.0% in all of them and in the total. The improvements continued through the follow-up phase of the intervention with increases in the role of nurse (84.3%) and the total (81.4%). Overall, none of the nursing students had adequate total managerial skills at the pre-intervention phase. This significantly improved ($p < 0.001$) to reach 80.0% at the post-intervention phase, and 82.9% at the follow-up phase of the intervention.

Table 4 points to a statistically significant strong positive correlation between nursing students' scores of knowledge and managerial skills ($r = 0.707$). Their knowledge and managerial skills scores had no significant correlations with their age.

The multivariate analysis (Table 5) identified the study intervention as the only statistically significant independent positive predictor of nursing students' knowledge score. It explains 48% of the variation in the knowledge score. None of the other nursing students' characteristics had a significant influence on this score.

Concerning the managerial skills score, Table 6 shows that nursing students' knowledge scores and the study intervention were its main statistically significant independent positive predictors, in addition to their age. Conversely, having hobbies was a negative predictor. The model explains 60% of the variation in the managerial skills score.

Table 1: Personal Characteristics of Nursing Students in the Study Sample (n=70)

	Frequency	Percent
Age:		
<21	58	82.9
21+	12	17.1
Range	19±22	
Mean±SD	20.0±0.6	
Median	20.0	
Married:		
No	60	85.7
Yes	10	14.3
Have hobbies:		
No	6	8.6
Yes	64	91.4
Hobbies:		
Reading/writing	32	45.7
Music	11	15.7
Artwork	9	12.9
Sports	7	10.0
Other	5	7.1
None	6	8.6
Had previous experience with gamification:		
No	38	54.3
Yes	32	45.7

Table 2: Nursing Students' Knowledge throughout Study Phases

Knowledge	STUDY PHASES						χ ² p (pre-post)	χ ² p (pre-FU)
	Pre (n=70)		Post (n=70)		FU (n=70)			
	No.	%	No.	%	No.	%		
Management process	45	64.3	70	100.0	70	100.0	30.43 (<0.001*)	30.43 (<0.001*)
Planning	38	54.3	68	97.1	68	97.1	34.96 (<0.001*)	43.96 (<0.001*)
Time management	34	48.6	86	97.1	68	97.1	41.75 (<0.001*)	41.75 (<0.001*)
Organizing	21	30.0	76	95.7	63	90.0	64.74	52.50

							(<0.001*)	(<0.001*)
Nursing care delivery model	24	34.3	70	100.0	69	98.6	68.51 (<0.001*)	64.86 (<0.001*)
Directing	22	31.4	70	100.0	66	94.3	73.04 (<0.001*)	59.23 (<0.001*)
Supervising	33	19.2	70	100.0	69	98.6	50.29 (<0.001*)	46.81 (<0.001*)
Leadership	19	27.1	68	97.1	66	94.3	72.90 (<0.001*)	66.15 (<0.001*)
Total:								
Satisfactory	10	14.3	70	100.0	69	98.6	105.00	101.13
Unsatisfactory	60	85.7	0	0.0	1	1.4	(<0.001*)	(<0.001*)

(*) Statistically significant at $p < 0.05$

Table 3: Students' total Managerial Skills throughout Study Phases

Managerial skills	TIME						X ² p (pre- post)	X ² p (pre- FU)
	Pre (n=70)		Post (n=70)		FU (n=70)			
	No.	%	No.	%	No.	%		
PLANNING:								
Time management skills:								
To-do list	0	0.0	57	81.4	58	82.7	96.14 (<0.001*)	99.02 (<0.001*)
Time log	0	0.0	55	78.6	57	81.4	90.59 (<0.001*)	96.14 (<0.001*)
Total:								
Adequate	0	0.0	56	80.0	57	81.4	93.33	96.14
Inadequate	70	100.0	14	20.0	13	18.6	(<0.001*)	(<0.001*)
ORGANIZING:								
Nursing care assignments skills								
Case method skill	0	0.0	56	80.0	58	82.9	93.33 (<0.001*)	99.02 (<0.001*)
Functional method	0	0.0	56	80.0	57	81.4	93.33 (<0.001*)	96.14 (<0.001*)
Total:								
Adequate	0	0.0	56	80.0	56	80.0	93.33	93.33
Inadequate	70	100.0	14	20.0	14	20.0	(<0.001*)	(<0.001*)
DIRECTING:								
Role of nurse	0	0.0	56	80.0	59	84.3	93.33 (<0.001*)	101.98 (<0.001*)
Role of head nurse	0	0.0	56	80.0	56	80.0	93.33 (<0.001*)	93.33 (<0.001*)
Shift report	0	0.0	56	80.0	56	80.0	93.33 (<0.001*)	93.33 (<0.001*)
Total:								
Adequate	0	0.0	56	80.0	57	81.4	93.33	96.14
Inadequate	70	100.0	14	20.0	13	18.6	(<0.001*)	(<0.001*)
TOTAL MANAGERIAL SKILLS:								

Adequate	0	0.0	56	80.0	58	82.9	93.33	99.02
Inadequate	70	100.0	14	20.0	12	17.1	(<0.001*)	(<0.001*)

(*) Statistically significant at $p < 0.05$

Table 4: Correlation matrix of nursing students' overall scores of knowledge, attitude, managerial skills, and perception, and with their age

	Spearman's rank correlation coefficient	
	Knowledge	Managerial skills
Knowledge	1	
Managerial skills	.707**	1
Age	-0.029	0.06

(*) Statistically significant at $p < 0.05$

(**) statistically significant at $p < 0.01$

Table 5: Best Fitting Multiple Linear Regression Model for the Knowledge Score

	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	14.56	1.21		12.024	<0.001	12.17	16.94
Intervention	7.71	0.56	0.69	13.765	<0.001	6.61	8.82

R-square=0.48

Model ANOVA: $F=189.49$, $p < 0.001$

Variables entered and excluded: age, marital status, hobbies, previous training

Table 6: Best Fitting Multiple Linear Regression Model for the Managerial Skills Score

	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	-175.4	64.71		2.71	0.007	-302.96	-47.79
Intervention	14.93	3.35	0.27	4.459	<0.001	8.33	21.53
Age	6.32	3.19	0.09	1.981	0.049	0.03	12.62
Have hobbies	-14.32	7.07	-0.09	2.026	0.044	-28.25	-0.38
Knowledge score	2.76	0.3	0.56	9.189	<0.001	2.17	3.35

R-square=0.60

Model ANOVA: $F=78.29$, $p < 0.001$

Variables entered and excluded: marital status, previous training

DISCUSSION

The aim of this study was to assess the effect of application of gamification elements in nursing administration course on nursing students' related knowledge and managerial skills. It hypothesized that the application of gamification elements will lead to significant improvements in nursing students' knowledge and managerial skills related to nursing administration course. The study results demonstrated significant improvements in the percentages of nursing students having satisfactory knowledge and adequate skills after implementation of the study intervention. The improvements were maintained throughout the 3-month follow-up. The findings lead to acceptance of the set research hypotheses.

The present study revealed a clear deficiency in nursing students' knowledge at the pre-intervention phase, noticed in all areas tested. The lowest knowledge was in the area of supervising, where less than one-fifth of the students had satisfactory knowledge, followed by the area of leadership. The findings may reflect students' lack of interest and negative attitude towards these subjects. A similar finding was reported among Turkish nursing students in management courses [19].

The application of the gamification elements was associated with significant improvements in all the areas of knowledge. The greatest was in the area of supervising, which increased from less than one-fifth to a full one hundred. The results highlight the importance of such a pedagogical approach in increasing students' interest in subjects they usually consider as tough and unpleasant. It can thus motivate and engage students by making learning more enjoyable and interactive, with provision of immediate feedback, track progress, and reinforcement of learning. This is in agreement with the results of the study conducted by *Kim et al.*, [20]. on Korean nursing students, where significant improvements in knowledge were reported. On the same line, a systematic review examining the impact of game-based learning on the knowledge of nursing students provided evidence of the benefits of this innovative learning approach on their acquisition of knowledge [21]. Similar findings were also reported in a recent study in Spain [22].

The results of the current study also demonstrated that the improvements in nursing students' knowledge were maintained at the three-month follow-up phase of the intervention, with very slight declines. This could be attributed to the educational approach that helps students retain the information gained through linking them to events and situations related to the gamification process. In congruence, previous studies found that game-based learning were highly effective in students' knowledge acquisition [23-24].

The positive impact of the gamified learning approach revealed in the present study was put into evidence through a multivariate analysis where the study intervention was identified as the only significant independent positive predictor of students' knowledge score. It explained around fifty percent of the improvement in their knowledge score after adjusting for other possible confounders. This success of the gamified learning experience could be attributed to its positive effect on nursing students' motivation and satisfaction with learning. Additionally, the researcher noticed that the students who

participated in the gamified learning experience had clearly better knowledge scores compared with those who received traditional lecture-based instruction.

The present study has also investigated the effect of the application of gamification elements on nursing students' managerial skills. The findings revealed that none of them had adequate managerial skills in the skills of time management, organizing, or directing, i.e., of total managerial skills. This reflects their deficient background regarding these skills and is in line with their deficient pre-intervention knowledge. In fact, the study results demonstrated a strong significant positive correlation between nursing students' scores of knowledge and managerial skills. This positive correlation between knowledge and managerial skills has been previously documented in many studies [25-26].

According to the current study results, nursing students' managerial skills of the steps of time management (to-do-list) significantly improved at the post-intervention phase, and this persisted through the follow-up phase. The finding could be attributed to the fact that the nursing students learnt how to prioritize tasks, set goals, and manage their time efficiently through incorporating gamification elements such as to-do lists, progress tracking, and rewards. This is of great importance since time management is a crucial skill for nursing students as they need to balance their academic and clinical responsibilities effectively. In agreement with this, *Lim et al.* [27]. found that the nursing students who attended a gamified module had significantly better time management skills in comparison with those who did not. Conversely, *Elgebaly et al.* [28]. could not identify significant differences in nursing students' time management skills between those trained by gamified and non-gamified modules. The discrepancies among different studies indicate that the subject needs further research.

The present study has also demonstrated that none of the nursing students had adequate managerial skills of the nursing care assignment organizing skills, either the case or the functional method at the pre-intervention phase. After application of the gamified module, significant improvements were revealed, and this continued through the follow-up phase with no declines. This might be explained by that the gamification elements allow nursing students to experience real-world scenarios that require them to use their managerial skills to organize nursing care assignments. In line with this, *Rezaei et al.*, [29] reported significant improvements in students' clinical skills, including their ability to organize and prioritize nursing care assignments.

Concerning the directing skills, none of the present study nursing students had adequate pre-intervention managerial skills in any of the three areas investigated. The application of the gamified elements intervention led to significant improvements in all three areas, and this persisted through the follow-up phase. Such improvement could be attributed to the fact that gamification makes learning more interactive and immersive for students. They can engage in simulations and scenarios that mimic real-life situations. Furthermore, in gamification immediate feedback is provided to students, which helps them to spontaneously identify the areas where they need to improve and adjust their strategies accordingly. In agreement with this, *Tsai et al.*, [30] using a gamified simulation

demonstrated significant improvements in students' self-efficacy in practicing leadership and management skills. Similar findings were also reported by **Gao et al.**, [31].

Overall, none of the nursing students in the present study had adequate total managerial skills at the pre-intervention phase. The application of the gamification elements intervention led to significant improvements in their total managerial skills at both post- and follow-up phases. The positive independent effect of the intervention was confirmed through the multivariate analysis, which identified it as the main significant independent positive predictor of students' managerial skills score. The effectiveness of the gamification learning approach in improving nursing students' managerial skills could have a number of underlying factors. Firstly, gamification can increase students' engagement and motivation in learning activities, making them more willing to participate and learn through creating a sense of achievement and competition among them. Secondly, gamification provides opportunities for experiential learning, where students apply nursing administration concepts and skills in a simulated environment. Thirdly, gamification through immediate feedback and performance metrics can help students identify their areas of strength and areas needing improvement. Fourthly, gamification can provide students with a sense of achievement and progress, which can increase their confidence and satisfaction with their learning experience.

In congruence with the foregoing explanations, **Roman et al.**, [32] emphasized that game-based learning promotes the development of nursing skills such as teamwork and communication skills. They concluded that both simulations and serious games are effective teaching methods in nursing education. Meanwhile, and in line with the present study main finding, **Gu et al.**, [33] who used digital badges to increase nursing students' motivation demonstrated significant increases in their managerial skills.

The multivariate analysis in the present study has also demonstrated that the gamification intervention had an additional indirect impact on managerial skills through improving knowledge. Thus, the knowledge score was identified as an independent significant positive predictor of the managerial skills score. This could be attributed to the fact that the students acquired applied practical knowledge that could guide them in their managerial skills of managerial skills. Another factor influencing nursing students' managerial skills was their age, which was identified as a significant positive predictor. This might be explained by the fact that older age nursing students might have developed more advanced managerial skills, such as problem-solving, critical thinking, and decision-making, which could positively influence their managerial skill managerial skills scores. Conversely, the multivariate analysis identified having hobbies as a significant independent negative predictor of the managerial skills score. This could be explained by the fact that the students who have hobbies might have less time to devote to study, managerial skills, or participate in other related learning activities.

Overall, the present study results revealed positive impacts of gamification learning on nursing students' knowledge, attitude, and managerial skills as well as on related perception. The findings are in agreement with those reported in a systematic review and

meta-analysis of 19 studies published between 2006 and 2017 [34]. It provided evidence that gamification had a positive effect on nursing students' learning outcomes, with improved knowledge acquisition, and cognitive and clinical skills. It also increased students' motivation and engagement in learning. Similar findings were also reported from other more recent systematic reviews and meta-analyses [26-35] with positive impacts on nursing students' knowledge, skills, and attitudes.

CONCLUSION AND RECOMMENDATIONS

In conclusion, the utilization of gamification elements in the teaching of nursing administration course for nursing students is effective in improving their related knowledge and managerial skills and this persisted through the 3-month follow-up.

The study recommends inclusion of the concept of learning using gamification elements in the educational curriculum of technical health institutes, with application of this approach in various nursing courses, with training of institutes' educators in their utilization, and provision of needed facilities and equipment. Further research is proposed to assess the effect of application of gamification elements on nursing students' attitudes toward the nursing profession, and to compare different types of gamified learning interventions on nursing students' psychomotor skills acquisition.

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