Comparing perceptions of nursing faculty and students to actual student performance in syringe measurement and use: An example of the Dunning-Kruger effect?

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Abstract

Introduction: A vital component of nursing education is the evaluation by faculty of student nurse's skill competence. Erroneous estimations of skill competence, as in syringe measurements and dosages, can be critical to patient safety. The Dunning-Kruger effect describes the overestimation/underestimation of skill competence. It is the professional responsibility of faculty and students to be able to assess actual versus perceived competence levels accurately.

Purpose: The purpose of this study was to compare the perceptions of nursing faculty and nursing students to student actual competence in syringe measurement and usage.

Methods: A cross-sectional, descriptive, comparative study conducted in a School of Nursing Skills Laboratory. Participants included faculty and 3rd and 4th year nursing students.

Results: The study sample included 96 students and 30 faculty members. Significant differences were found between faculty perception and student perception of competence (p=0.001). The actual successful performance of all students was lower than expected; 3rd year students had a higher perception of their skill competence than their actual performance, and 4th year students performing at a lower level than 3rd year students (p=0.001).

Discussion: Nursing faculty educators and upper-class nursing students perceived a higher level of competence than actual performance. This supports the Dunning Kruger effect and behooves nursing faculty and students to be more precise in their assessments.

Conclusions: In today's milieu of online teaching, keen awareness and objectivity regarding clinical skills competence is imperative for client safety. A longitudinal study measuring perception of competence as compared with actual skill performance is warranted.

Keywords: Syringe measurements; Skills; Competencies; Students; Nursing Education; Dunning Kruger effect.

Introduction

An intrinsic part of nursing education is the teaching of specific nursing skills (Alexander & Runciman, 2003). These skills are eventually integrated into the tapestry of knowledge, assessment, intervention, and evaluation of the practicing professional nurse. The expectation from professional licensing bodies is that graduates of a recognized nursing program will have reached a standard of professional preparation for competent and safe practice for which they can be held accountable.

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Competence is defined in terms of functional adequacy and the capacity to integrate knowledge, skills, attitudes, and values in specific contextual situations of practice (Meretoja & Leino-Kilpi, 2003, 405). Senior nursing students are expected to have competence in fulfilling their responsibilities both safely and effectively. Educational instructions do not always give the student the necessary ability to make the jump between the nursing training process and clinical performance (Heidari & Norouzadeh, 2015, 40) though nursing faculty may have an expectation that theoretical and clinical education will empower the student to grow in their skill competence. Therefore, there is a need for assessment of competence in nursing care (WHO, 2008,46).

Nursing educators provide nursing students with a wide variety of clinical learning opportunities. Clinical teaching takes place in both the classroom/laboratory and the actual clinical field where the nursing students will eventually work. This includes planning, providing and evaluating clinical experiences. Each student, however, experiences their clinical learning opportunities in a different way (Gaberson et al., 2014, 75).

Skill acquisition is a complex process involving trial and error, with the ideal being that the students will learn from their mistakes and their mistakes will be either fixable or not life threatening or changing. Nursing faculty members have the tendency to expect competence early in the clinical teaching process (Gaberson et al., 2014, 76). This discrepancy between the learning process of the student and the expectation of the faculty can create a difference in perception of skill competence. Managers assessed the overall level of competence (70.8 ± 19.3 vs. 63.9 ± 13.7) (mean ± SD) and the level of competence in five competence categories significantly higher than the nurses themselves. Managers assessed the overall level of competence (70.8 ± 19.3 vs. 63.9 ± 13.7) (mean ± SD) and the level of competence in five competence categories significantly higher than the nurses themselves.

There is no found published literature on the comparison of perception of skill competence between nursing faculty and students. Studies have been done comparing perception of nursing managers and nurses concerning skill competence. Most studies date back 5–15 years, employ varied instruments, and focus on the graduation phase (Meretoja & Leino-Kilpi, 2003 p. 405). One study was published over 12 years ago exploring the agreement between the assessments made by nurses and their managers, concerning the level of nurse competence. Managers assessed the overall level of competence (70.8 ± 19.3 vs. 63.9 ± 13.7) (mean ± SD) and the level of competence in five skill categories significantly higher than the nurses themselves (Meretoja & Leino-Kilpi, 2003 p. 406). In 2006, Lofmark and colleagues conducted a study to compare final year student nurses' (N=106) views of their own competence with qualified nurses' (N=136) perceptions of newly graduated nurses' competence. The main finding was that final year nursing students rated themselves higher as having a good or strongly developed ability to provide nursing care than rated by experienced nurses (p < 0.0001) (Loftmark et al., 2006, p.724). Nursing faculty need to be able to realistically rate the competence of nursing students as they move from the level of novice to expert (Benner, 1984, 406). Nursing students need to realistically recognize their competence level in order to develop their personal goals.

The challenge of erroneous estimations of skill competence is described in the social psychology literature. In 1999, Kruger and Dunning described social experiments where college students were asked to estimate their performance on tests involving humor, grammar, and logic. Students who performed poorly often overestimated their performance whereas students who performed well often subjectively underestimated their performance. The researchers further surmised that not only do these students reach erroneous conclusions and make unfortunate choices, but their lack of ability to correctly judge their competence actually robs them of the metacognitive ability to realize it (Kruger & Dunning, 1999, 31). In other words, there is a tendency for people whose skills are poor to overestimate their abilities and status. Further studies found that inaccurate self-assessments in low-performing individuals are explained both by lack of insight into their own performance and by lack of accurate perception of high-performing individuals (for example, faculty)

of their peers' performances (Raat et al., 2013, p. 195). This effect can have grave consequences in nursing education.

The BSN curriculum in our institution includes a 4-year program with close to 1300 hours of clinical teaching for clinical competence. All basic science courses are taught in the first two years. The clinical nursing courses are divided into theoretical teaching (knowledge base) and clinical instruction (clinical evidence based learning and clinical skills). In the first year, three courses are taught as part of "Foundations of Nursing Practice", in which clinical skills are presented. These courses form the basis of clinical skill learning.

Syringe measurement and usage skills are a basic skill of nursing. Multiple manipulations (dilutions, transfer from syringe to syringe) of injectable medications require finely honed skills to avoid mistakes in clinical real time (Grissinger, 2010, 428). Accurate assessment of this skill, by both the students themselves and faculty members, are vital when striving for competence. Competence in this skill is part of an effort to prevent medication errors which is a universal initiative for patient safety and healthcare-based risk management (Issenberg & Scalese, 2008, 32).

A high incidence of medication errors and near miss events by nursing students was reported in a 2018 systematic review (Asensi-Vicente et al., 2018, E2). Furthermore, in a one-year retrospective review of a pediatric emergency department, evidence showed dose medication errors are highly prevalent, whether under-dosing or overdosing, by nurses, where pharmacist verification was bypassed in emergency care (Todd et al., 2021, p. e1309). In the literature, medication errors have been correlated with a complexed dynamic working environment (Sabzi et al., 2019, 3580).

Relevancy of the research

For over 30 years, accrediting bodies of higher education have held nursing schools accountable for the outcomes of their education programs (Dillard & Sitkberg, 2012, 22). This examination of the perceptions of both faculty and student and the actual skills of the student nurses during the learning process can contribute to the refining of the educational objectives, strategies, and clinical experiences. Ultimately such an effort can improve the schools' abilities to offer optimal educational opportunities for skill acquisition.

The purpose of this study was to compare the perceptions of nursing faculty and nursing students to student actual competence in syringe measurement and usage. It aimed to answer three research questions. What is the perception of the nursing faculty of the competence of the 3rd and 4th year nursing BSN students regarding syringe measurements and usage? What is the perception of 3rd year BSN nursing students of their competence regarding syringe measurements and usage? What is the level of actual performance of 3rd and 4th year BSN nursing students regarding syringe measurements and usage?

Methods

Type of study

The present study is a comparative descriptive cross-sectional study.

Sample

This research used a convenience sample drawn from all the 3rd and 4th year nursing students and the nursing faculty of a university based undergraduate program in the center of Israel. Students who were studying for a 3rd or 4th year who do not belong to the original class cohort were excluded from the study. Student participation in the study was high (3rd year- 99%; 4th year- 90%). All the school faculty (except for the authors) were included in the study. It is important to note that almost all the clinical teaching faculty have post basic certification in clinical teaching.

Instruments

The present study employed several data collection tools considering that both faculty and students were being studied.

Faculty

A demographic and professional background questionnaire was administered. Questions were included concerning theoretical and clinical teaching experience in syringe measurement and usage and the faculty's opinion of 3rd and 4th year nursing students' competence in performing syringe measurement and usage (supplemental material). The tool consisted of three separate items that examined different aspects of the same clinical skill. For example: "What do you believe is the percentage of nursing students in the 3rd year who can fully perform drawing a certain volume into a syringe?" The faculty member was asked to indicate the percentage of students (overall) who, in his/her assessment, would successfully complete the skill's task being measured.

Students

The personal background questionnaire included demographic data and work experience in patient care (outside of clinical rotations).

The students were given a questionnaire to examine their opinion of their ability to perform syringe measurement. The questionnaire consisted of three separate items that examined different aspects of the syringe measurement. For example: Students were asked "To what degree (in percentage) would he or she be able to fully draw up a certain volume into a syringe?" (See Appendix A).

The Student Skill Performance Form described details of the syringe measurement and usage task. Syringe measurements included syringe unit markings, whereas syringe usage included "drawing up" of liquid (NS) under different conditions –identical volumes with variable syringes, and differing volumes with identical syringes. Attached to the explanation page were two envelopes with materials such as syringes, vials of fluid for extraction, etc.

The student evaluation form recorded the percentage of correct performances of the actual skill. This form included a table with places marked for correct execution / wrong execution of each skill being tested. All the forms were anonymous and did not include student identification information.

Data Collection

After the approval of the university ethics committee and the director of the school, the school staff was approached during a monthly staff meeting. The purpose of the study was delineated, and the faculty questionnaires were distributed and collected before the students were approached. During the same timeframe, 3rd and 4th year generic nursing students were recruited during a weekly meeting to explain the purpose and duration of the research. During school hours, all the 3rd year students were invited at the same time to the skills lab in the school. On the following day, a similar procedure was carried out for all 4th year students.

Students who agreed to participate in the study were invited to the school skills lab, where the process was conducted in two steps. Step 1: Students were asked to fill out a questionnaire on their perceptions of their own ability to perform syringe measurements. Step 2: Each student received a guide form for syringe measurements and an envelope with measurement equipment for syringe use. Upon completion of the skill task, the student placed the forms and materials on a designated surface and left the room. Throughout the process, the student was not identified by name and there were no interactions with the research team. Only in the case of questions for clarity, the student could query a volunteer nurse (not one of the researchers) who were observers in the room. The process took approximately one hour with students offered light refreshments on completion of the tasks. After all the students finished the tasks, the research team collected the forms and materials for evaluation. Evaluation of competence was done by one researcher to avoid issues of interrater reliability. Intra-rater reliability was performed during a simulation of the research task before the actual data collection day.

Data Analysis

All data collected was submitted to an Excel database and processed using the SPSS program (19.0). Descriptive statistics for the different variables of the research participants and the research questions included means, standard deviation, median and response ranges. To examine the differences between the faculty's perception of clinical proficiency and the actual performance of students in the 3rd and 4th year, an ANOVA test was performed. Kappa and Wilcoxin analyses were used to analyze the measure of agreement between the perceptions of students in the 3rd year of their own ability to perform syringe measurements with their actual performance of that skill. T-test was performed to examine the percentage of correct performance of the syringe measurement and usage of 3rd year students relative to the 4th year.

Ethical considerations

IRB approval was given and exemption from written informed consent was approved in to guarantee anonymity and reduce any concern of the students that their performance would affect their grades. Participants (both faculty and students) received an explanation of the purpose of the study, knowing that their participation was voluntary and that they may withdraw from the research at any time. On completion of the study instruments, all questionnaires were collected and stored as per the guidelines of the institutional ethical committee.

Results

Characteristics of the study's sample are presented in Tables 1 and 2. The majority of the faculty and the students were women. Students' mean age was 23.8 years (range 20-40). Over half of 3rd year students work as salaried nursing assistants in direct patient care, with the majority (80%) of 4th year students working as well. Faculty's mean age was 50.4 (range 36-67), with the majority holding Master or PhD degrees with at least 16 years of clinical experience. Thirty percent of the faculty were young nurse educators (1-5 years' experience), with 87% having completed a post basic clinical instructor course. Approximately two thirds of the faculty administer medication with students during clinical rotations and the majority report on teaching syringe measurement and usage skills.

Table 1: Characteristics of sampled students

Characteristic	3rd year students		4th year students	
	n=51	%	n=45	%
Gender				
Male	7	13.7	11	24.4
Female	44	86.3	34	75.6
Work related to clinical patient care				
Yes	30	58.8	36	80.0
No	21	41.2	9	20.0

Table 2 : Characteristics of sampled faculty (N=30)

Characteristic	n	%
Gender		
Male	2	6.7
Female	27	90.0
Education in nursing		
Baccalaureate degree	3	10.0
Master or PhD	27	90.0
Years of experience in the clinical area		
7 to 15	6.0	20
16 to 25	10.0	33.3
26 to 35	7.0	23.3
36 and above	5.0	16.7
Years of experience as a nursing educator		
1 to 5	10.0	33.3
6 to 15	11.0	36.7
16 <	8.0	26.7
Post basic clinical instructor course		
yes	26	86.7
no	4	13.3
Teach syringe measurement skills		
yes	20	66.7
no	10	33.3
Teaching of syringe using skills		
yes	21	70.0
no	8	26.7
Medication administration with ídents in clinical teaching		
yes	20	66.7
no	3	10.0

Faculty had a high perception of 3rd year students' competence in all three skills with a total mean score of 2.5 (0-3 range), and an even higher perception for 4th year students with a total mean score of 2.6 (Table 2). Students' actual syringe volume competence for both 3rd and 4th year students, was a mean score of 1.7, significantly lower than the faculty's perception (p=0.001).

Table 3: Comparison of faculty perceptions and actual student competency

	Faculty's perception of student's competency			Students' competency		actual	
	n	mean	SD	n	mean	SD	95% CI
3rd year students							
Syringe unit markings*	26	8.4	1.9	48	6.7	1.9	0.92-2.52
Syringe volume measurement, variable syringes*	26	8.3	1.9	36	5.3	1.9	2.26-3.84
Same syringe volume measurements, variable syringes**	26	8.3	1.9	34	7.4	1.9	0.15-1.75

Syringe volume total score*	26	2.5	5.7	38	1.7	0.6	0.06-1.06
Syringe unit markings***	27	8.8	1.8	45	7.6	1.8	4.45-1.91
Syringe volume measurement, variable syringes*	27	8.9	1.7	41	4.4	1.7	3.87-5.18
Same syringe volume measurements, variable syringes**	27	8.7	1.9	41	5.1	1.9	2.83-4.38
Syringe volume total score*	27	2.6	5.2	43	1.7	0.8	0.79-1.19

*$p<0.001$; **$p=0.02$; ***$p=0.03$

When comparing 3rd year students' perception of their syringe competence to their own actual performance (Table 3), the differences between perception and performance are not significant. Yet, when all three competencies were summarized, students' perception of their own performance was higher than their actual performance (mean rank 2.8 and 1.68 respectively, $p=0.001$).

Table 4: Agreement between students' perception of their competency to their actual performance in syringe volume (n=51)

	Students' correct performance				
	n	%	Missing (%)	Kappa	p
Syringe unit markings	32	66.7	3 (5.9)	-0.41	0.48
Syringe volume measurement, variable syringes	19	37.3	15 (29.4)	-0.11	0.17
Same syringe volume measurements, variable syringes	25	49	17 (33.3)	-0.06	0.54

There is no difference in performance of syringe competencies between 3rd year students and 4th year students. A difference was found only when students were asked to measure same syringe volume in variable syringes- 3rd year students performed better than 4th year students (0.04).

Table 5: Frequency (%) of correct syringe competency, comparison of 3rd year to 4th year students' actual performance

	Correct performance n (%)		
	3rd year (n=51)	4th year(n=45)	p
Syringe unit markings	32 (48.5)	34 (51.5)	0.35
Syringe volume measurement, variable syringes	19 (51.4)	18 (48.6)	0.44
Same syringe volume measurements, variable syringes	25 (54.3)	21 (45.7)	0.04
All 3 competencies (total score)	12 (48.0)	13 (52.0)	0.15

Discussion

This study is the first of its kind in examining perception of competence vis a vis actual competence of students and the perception of their faculty. The perception of 3rd year BSN nursing students of their competence regarding syringe measurements and usage was higher than their actual performance. Faculty also had a very high perception of competence of the students to perform syringe measurements and usage. They showed an overestimation of the abilities of the students in both the 3rd and 4th year of their studies, considering that the results showed that students' actual performance was below the expectations of the faculty.

These findings support the assertion of the Dunning Kruger effect. Recognizing the Dunning–Kruger effect's relevancy to the developmental educational milestones set for nursing students especially concerning clinical skills, could help focus faculty in empowering students to realistically assess their professional development, clinical expertise, and sense of self-confidence. It encourages students to be introspective, recognize their strengths and weaknesses, and be aware of the important balance necessary between self-confidence and self-critique when assessing personal clinical competence (Rahmani, 2020, 533). It also behooves the faculty to be aware of the tendency for overestimation of student skill ability. This overestimation can result in not meeting of student educational needs or worse, clinical mistakes in patient care that can affect patient safety.

It must be mentioned that the classic interpretation of the Dunning–Kruger effect has been challenged by alternative explanations. It has been suggested that the observed overconfidence of poor performers is an instance of regression to the mean: the statistical tendency of extreme samples (here, poor performers) to move toward the group mean when resampled (here, in the form of retrospective performance evaluation). This interpretation identified the origin of the Dunning–Kruger effect in the statistical reasoning of scientists, statistical noise you may say, and not necessarily a phenomenon of its own (Mazor & Fleming, 2021, 677). Though this critique is noted, the Dunning–Kruger effect is still a social theory that is supported in current literature.

In a narrative review of the international literature concerning an overview of summative assessments of student nurses' practice by clinical preceptors (non- school based clinical educators), the 23 papers included displayed inconsistencies in clinical preceptor assessments of students. One of the most salient points of this review was the issue of "failure to fail" (Helminen et al., 2016, 317). Clinical preceptors and educators are concerned about giving a good clinical experience to the students and there is a tendency to give higher grades than what the student nurses deserve (Wells & McLoughlin, 2014, 140). Grade inflation was indicated in other research as well (Helminen et al., 2014, 1163). In this study, the overestimation as not displayed in grades or a "failure to fail". The overestimation was reported in real time perception of the faculty, making the issue even more significant.

The literature offers a different understanding of nursing competence. Nursing students may need to practice self-assessment during their nursing education to be able to do self-monitoring of their development, successes, and areas of needed improvement (Kajander-Unkuri et al., 2016, 309). Third year nursing students in the present study begin their clinical rotations at the end of the first semester. That timing is over a half a year from their skills laboratory assessments. It is possible that the students performed well in their skills lab assessments and were left with a feeling of over-confidence. Self-confidence of students has been studied in terms of timing in the curriculum and students unrealistically high perceptions of their level of competence (Lakanmaa et al., 2012, 650; Lauder et al., 2008, 1865; Lofmark et al., 2006, 726). Nurse educators need to take this issue into consideration both in the development of the nursing students' professional persona and honing of clinical skills. Student confidence is an important component of professional behavior, but it can also be a source of clinical errors. Usher et al. (2017, p.94) concluded from a study of student nurses, and their confidence in patient safety knowledge that, in order to contribute meaningful improvements in patient safety, nursing students need to develop a level of self-confidence, especially in recognizing clinical errors and near misses. A balance between confidence and responsibility for competence is a nursing education challenge.

In the present study, the 3rd and 4th year BSN nursing students' actual skill competence regarding syringe measurements and usage was poor to fair, at best, though the differences were not statistically significant. This was surprising to the authors, especially concerning the 4th year students, considering the extensive clinical hours the students have in their curriculum. Except for recognition of dosage markings, the 4th year students had actually poorer competence than the 3rd year students. When attempting to understand this phenomena, the authors wondered - could the 4th year students, older and working on the wards as nurses' aides after hours, be over confident, having picked up

"short cut habits" and in addition, possibly had not been tested on this skill since the start of their clinical rotations? This reality would need to be examined in additional studies. In addition, the authors thought of the skill itself, a skill that requires human precision as opposed to digital automation (van Laar & de Haan, 2016, 578). When looking at other skills, whether it be taking of temperature, pulse, blood pressure- in today's digital world, human precision has been replaced with technological expertise. Nurse educators need to realize that nursing skills bridge the human with the digital and not lose sight of the importance of practicing human precision in skills building.

Limitations

This study employed a convenience sample of 3rd and 4th year nursing students in a single BSN 4-year program. Therefore, its generalizability is limited. This study had a cross-sectional design with students participating long after their formal skills laboratory assessments (6 months - 3rd year nursing students; 1.5 years - 4th year nursing students). In addition, the 4th year BSN nursing students' perceptions of syringe measurement and usage competence was not measured due to a logistical issue.

Conclusions

Clinical competencies of senior nursing students are a pivotal indicator for professional standards of practice and patient safety; therefore, clinical assessment is a crucial issue for educators and school of nursing administrators (Wu et al., 2015, 348). The present study found that nursing faculty educators and 3rd and 4th year nursing students perceive a higher level of student competence than their actual performance on syringe measurement and usage supporting the Dunning–Kruger effect. It is the only found study that included actual performance as a main variable. In the future, a longitudinal study where students are followed concerning their perception and actual performance of skills throughout their education from skills lab to graduation will offer insight into student competence and the moment when their confidence does not match their ability. This awareness in real time will allow for refining of skills and improving accurate assessments by both faculty and students themselves. It is apparent from this research that an objective assessment tool of competencies that is brief yet detailed and valid needs to be developed so that nursing students and faculty can consistently follow progress at designated times throughout the curriculum.

Patient safety is based on both the care environment and nursing professionalism. The information gleaned from this research is an important part of reaching this goal. Conflicts of interest: none

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Appendix:
Questionnaires used to collect data on perceptions of faculty and students

1) Questionnaire on faculty perception of students' ability to perform syringe measurements and usage

Instructions: Considering an average clinical group of 10 students, please specify how many 3rd and 4th year students (from 0 to 10) will be able to fully perform (100% performance) the following skill:

Skill: Syringe Measurement	3rd year	4th year
	0-10 students	0-10 students
Specify dose markings on 2 different syringes (1ml, 20ml(		
Draw up a designated volume in a syringe (Example: 1.4 ml in a 10ml syringe)		
Draw up the same volume in different syringes (Such as aspirate 2.4 ml in 5ml syringe and 10ml syringe)		

2) Questionnaire on the students' self-perception of their ability to perform syringe measurements and usage

Instructions: Dear student: Specify whether or not you will be able to fully perform (100% performance) the following skill:

Skill: Syringe Measurement	Can perform	Can't perform
Specify dose markings of 2 different syringes (1ml, 20ml)		
Draw up a designated volume in a syringe (Example: 1.4 ml in a 10ml syringe)		
Draw up the same volume in different syringes (Such as aspirate 2.4 ml in 5ml syringe and 10ml syringe)		