Implementing and evaluating student active learning in a one-day statistics course

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Background

The one-year educational and training program at the Cardiac Centre (Rigshospitalet) is a project-oriented course designed for experienced nurses with the aim of improving the professional patient care while fostering the acquisition of new competencies (see Appendix 1). The program operates through two tracks, with one focusing on a clinical project, including theoretical education, and the other aimed at enhancing nurses' organizational competencies to lead minor change-processes and implement the knowledge generated by the project. Projects can apply qualitative and/or quantitative methods, depending on the research focus. A clinical nursing specialist or a PhD-student from the department serves as the primary project supervisor. The course typically enrols approximately 12 participants.

The theoretical part of the program spans 18 full course days, including a full day dedicated to statistical concepts and quantitative methods, which forms the central focus of this UP project. The participants' prerequisites and motivations for acquiring knowledge in statistics and quantitative methods vary considerably. Some participants may use these methods in their own projects, showing a particular interest in gaining proficiency in the area. Conversely, participants employing qualitative methods may lack the same incentive to study and learn the associated statistical methods. All participants have completed their bachelor’s degree and are expected to possess a basic understanding of quantitative methods from their education. However, there is considerable variation in how long ago they were studying and how extensively they have engaged with research literature in their practical work.

Previous evaluations have indicated that students perceive the statistics day as being at too advanced a level, lacking relevance to their

projects and clinical practice, and not facilitating the anticipated understanding of the material. It is also the author's personal experience that later in the overall course, questions posed by students indicate that the intended learning objectives of the statistic course have not been achieved. A previous participant articulated that 'the learning outcome for me is simply not significant enough, considering that we have a full day of lectures' Moreover, past experiences also indicate that despite the expectations set by the teacher, students have not adequately prepared themselves for the provided material.

Previous intended learning objectives (ILOs) for the statistics day have been quite ambitious, employing taxonomies such as 'understanding of...' and 'application of...'. Considering the relatively limited duration and the participants' known prerequisites, this may have contributed to the frustration (Mørcke & Rump, 2020). The overarching goals for the entire one-year course utilize taxonomies such as 'increasing participants' knowledge within', 'enhancing insight into methods...', and 'gaining knowledge of...', which might make 'understanding and applying statistical concepts' appear overly ambitious (Mørcke & Rump, 2020) (Appendix 1).

Among course teachers, there has been increasing acknowledgement of the need to improve quality of the teaching and create better alignment between participant prerequisites, learning objectives, and teaching methods.

Methodological considerations important for this project

According to Illeris (2018), learning can be seen as comprising three key dimensions: content, interaction, and incentive (Figure 1). The **content** dimension concerns what is learned. This is usually described as knowledge and skills, but also many other things such as opinions, insight, meaning, attitudes, values, ways of behaviour, methods, strategies, etc. may be involved as learning content and contribute to building the understanding and the capacity of the learner. The **interaction** dimension provides the impulses that initiate the learning process. This may take place as perception, transmission, experience, imitation, activity, participation, etc. All learning happens in interaction

with the world (Illeris, 2006) The **incentive** dimension provides and directs the mental energy that is necessary for the learning process to take place. It comprises elements such as feelings, emotions, motivation, and volition [the use of will]. Furthermore, two basic processes are at play in every learning situation: the interaction between an individual and their environment, and acquisition involving both content and incentive (Illeris, 2006), (Figure 1). Learning is thus a complex process, and the absence of learning can be attributed to a multitude of factors.

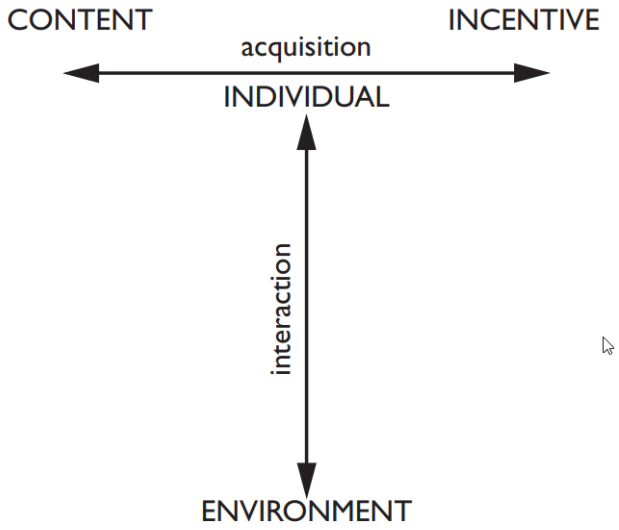

Fig. 1. The Fundamental processes of learning. (Illeris, 2018)

Student Active Learning is a teaching format that places students at the forefront, enabling them to play a more prominent role in shaping and driving the lecture compared to traditional teaching methods. Instead of passively receiving information, students engage in discussions with their peers, collaborate in groups for shorter durations, and interact with the teacher through dialogues to grasp the subject matter presented in the lecture. This pedagogical approach centres on empowerment of students, shifting the focus from teacher-centred to student-centred learning, and emphasizes peer collaboration (Michael, 2006; Springer, 1999). Research has consistently demonstrated numerous advantages of the Student

Active Learning format, e.g., improved test scores (Freeman, 2014; Springer, 1999).

Purpose

The overall aim of this project has been to design, implement and evaluate a higher degree of student active learning and a number of engaging elements in the teaching of theoretical statistics, with the purpose of enhancing learning outcomes and improving the quality of the teaching.

Rethinking and evaluation the statistics course day

To fulfill the purpose, an intervention consisting of multiple components was implemented, and an evaluation was conducted. Multiple activities were chosen because: knowledge and skills are acquired through active interaction with the subject matter, and in dialogue; it maintains critical thinking; it sustains attention; it facilitates learning from peers; it is better for the students to participate in an academic discourse community, not just observe it; it allows the teacher to observe and facilitate learning (Rienecker et al., 2020).

The intervention, included the following steps:

1. New ILOs were defined for this specific course day. The focus was on clarifying learning objectives so precisely that both the instructor and students understood their purpose (Mørcke & Rump, 2020).
2. A week before the statistics day, the teacher approached the students and provided them with three questions for plenary reflection and for further contemplation at home, in preparation for the upcoming statistics day: What quantitative research designs do you know? What statistical concepts do you know? What do you expect to take home from the statistics teaching? This was done with the aim of fostering early reflection on their own practices and increasing the chances of the participants preparing. Additionally, it was done to some extent to accommodate their wishes for topics.
3. The first 20 minutes of the statistics day were dedicated to reviewing the participants' reflections from the last time and

the topics they wished to acquire knowledge about (what they expected to take home). These were noted on a flip-over and a chalkboard. Throughout the statistics course day's teaching and in the concluding session during the recap, reference was made continuously to these topics with the aim of creating alignment between student expectations and content. Finally, a strategy was agreed upon for how the participants could find information about the topics that had not been covered in the sessions.

4. Teaching was designed to emphasize dialogue-based teaching include group work involving research articles, calculation exercises, and plenary discussions and presentations.

Evaluation

To assess the effectiveness of the intervention, two evaluation methods were applied:

1. To assess whether the participants have acquired knowledge of presented concepts and topics, and to serve as a proxy for achieving the learning objectives, a quiz was conducted in the form of multiple-choice questions as well as true/false statements. The quiz, developed in the Socrative format (see Appendix 2), covered seven specific areas that aligned with the ILOs and served as instant feedback to both teachers and participants on the acquired knowledge. Approximately halfway into the course day, the quiz was administered. The 11 participants were asked to log in individually and anonymously to complete the quiz, and the results were displayed immediately on the screen after the quiz had been completed. The responses served as feedback for both the instructor and the participants, indicating whether knowledge of the covered concepts had been acquired (Rienecker et al., 2015).

2. A Delphi evaluation including post-its was conducted to gather the participants' feedback on the intended learning objectives (Horste et al., 2020). This activity served as an evaluation, where each

student wrote key points on post-it notes. These key points formed the basis for a dialogue between the teacher and the participants regarding the teaching and the intended and achieved learning outcomes. This activity ensures that the students' voices are heard and contributes to the alignment of expectations and evaluation of the effectiveness of the instruction, which is crucial for effective teaching. To prevent this process from becoming time-consuming and unproductive, the Delphi evaluation was used as a starting point for a constructive dialogue and a quick assessment of the students' perception of the teaching. Prior to the evaluation, participants were presented with the learning objectives and given the following instruction: ‘On the yellow post-it notes: With a focus on learning objectives and the quality of the teaching, write one aspect that worked well and one aspect that could be improved. Once both points are written, keep passing post-it notes to the right, and if the neighbouring student agrees, a mark is added’. Subsequently, the post-it notes are grouped on a whiteboard, and the topics with the most marks are discussed in a plenary session.

Results and reflections

The results from the Socrative quiz and the Delphi evaluation are presented and reflected upon in relation to Rienecker and Bruun's thoughts on feedback and quizzes in teaching (Rienecker & Bruun, 2020), and Illeris' model 'fundamental processes of learning’ (Illeris, 2006/2018).

Socrative quiz

The quiz revealed that the participants had given incorrect answers on several topics, more precisely in four out of seven questions (Appendix 3). The initial idea was to use the answers exclusively to adapt future teaching, but after reflecting with my pedagogical supervisor I changed my strategy and involved the participants in a subsequent dialogue. This dialogue provided the opportunity for both the teacher and the

participants to collectively revisit topics that required a deeper explanation or reformulation, also addressed by Rienecker &Bruun (2020). In the context of this dialogue, I was particularly mindful of avoiding a dictatorial or accusatory approach regarding the incorrect responses. Instead, I adopted an appreciative and humble stance to maintain a trusting and safe learning environment—a crucial element in the interactional dimension, which constitutes a prerequisite for learning (Illeris, 2006).

In one specific true/false question regarding whether gender is a continuous or categorical variable, four out of eleven participants provided incorrect answers. This was surprising, as this topic had seemed well-received during the lesson, with positive responses and students asking clarifying questions, suggesting a high level of engagement and interaction. However, as pointed out by Illeris (2006), mere interaction might not be sufficient for effective learning, and the actual acquisition of knowledge might have been insufficient in this instance. It is not uncommon within the nursing community to perceive statistics as a challenging subject, and possibly, participant prerequisites were overestimated, or their incentive towards learning may have played a role.

Conducting the quiz halfway through the teaching allowed me to re-address the topics where participants had not answered correctly, likely enhancing the learning outcomes for the first half part of the day. As I did not apply a quiz at the end, it was a challenge to assess the learning outcomes for the final part of the course day. Including a quiz or other feedback options at the very end could have offered an overview of unlearned topics, facilitating further discussions and reflections.

An additional reflection relates to the fact that the participants responded individually yet anonymously by numbers or letters they chose for themselves. As the teacher, this gives me the opportunity to see everyone’s individual answers, while also enabling the participants to collectively reflect on the questions and perhaps arrive at different perceptions based on others' considerations. Anonymity ensures that no participants feel exposed, but it also deprives the teacher of the chance to identify the weakest participants and provide them with further support.

Delphi evaluation

The result of the Delphi evaluation is presented in Figure 2. On the left-hand side, the participants' suggestions worked well in the teaching are displayed, while on the right-hand side, aspects that needs improvement are shown. Ten participants took part in the Delphi evaluation.

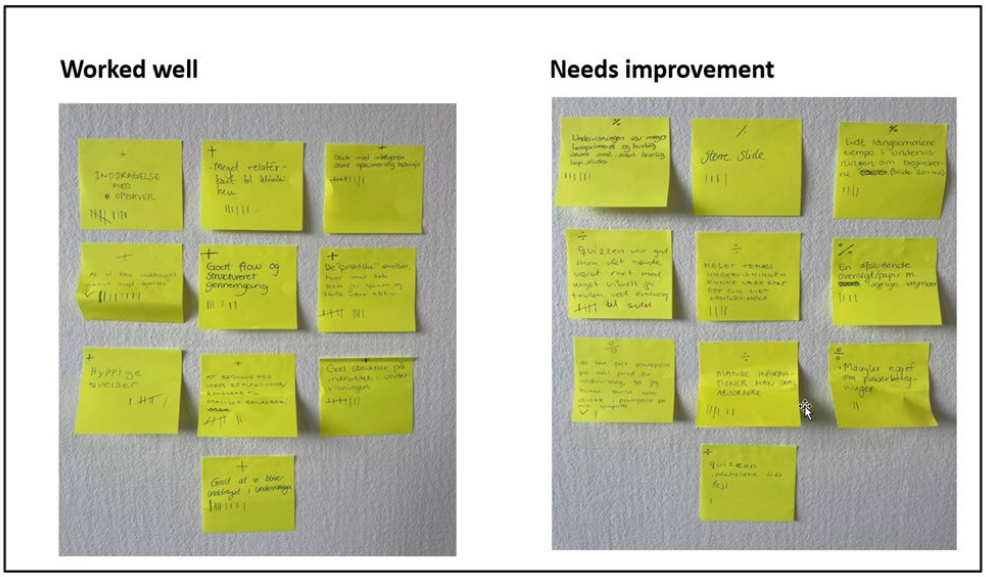

Fig. 2. Results from the Delphi evaluation

The main advantage of this evaluation method lies in its ability to provide a thematic overview of evaluation trends within a short timeframe. Additionally, it ensures that all voices and opinions are considered democratically, fostering inclusivity and interaction. During the concluding plenary discussion, particular attention is given to statements that have received the most marks, empowering students to actively contribute to setting the agenda (Horst, 2020).

Worked well

Among the topics that worked well there were numerous that received a significant number of marks; ‘Practical exercises’, ‘frequent exercises’, ‘involving activities’, and ‘good to be included in the teaching’ all indicated that the purpose of introducing student active learning had succeeded. Also, by requesting the students to evaluate the teaching based on the learning objectives, it can be assumed that the enhanced level of

student active learning played a crucial role in creating a positive perception of the teaching quality.

Needs improvement

Overall, there was a notable diversity in the key points suggested for improvement. The key points that received the highest number of marks were related to the concerns about the amount of information that needed to be absorbed and the pace of the teaching. Several students expressed frustration that teaching was going too fast. Other key points were not having the power point in advance and difficulties reading the distributed power point slides due to small size, and the absence of a concluding summary slide at the end of the day.

When the pace is overly fast, it can impede interaction and, leading to a potential decline in motivation and incentive for learning (Illeris, 2006). It is worth exploring whether adjusting the content's ambition and reducing the number of topics and allocating more time to each topic would improve learning outcomes. This might call for revision of the material and incorporation of even more interactive exercises in future courses.

A conscious choice was made to omit a traditional summarizing slide. Instead, continuous referencing to the topics raised by the participants themselves (at the reflection a week a head of the course day). The ultimate goal was to integrate these topics into participants' own practice and institutionalize their relevance. The teaching should promote learning, but it is not guaranteed to happen solely within the teaching situation itself (Dolin, 2020). Well-designed power point material including a summarizing slide, will provide the participants with the opportunity to revisit the key conclusions later and potentially relate them to their projects and other future challenges they may encounter in their professional lives and thereby increase the incentive dimension as described by Illeris (2006).

I deliberately decided not to distribute the material before the statistics day, a practice I rarely do. My concern is that participants might solely focus on the PowerPoint material and overlook the provided literature. On the other hand, distributing the materials on the course day would allow participants the opportunity to take notes. Withholding the

material might increase the focus on the teaching and enhance interaction; however, it might also pose difficulties for participants to take good notes.

Further personal reflections

Before attending the university pedagogy course, incorporating quizzes into my teaching was unfamiliar for me. However, I have used it several times within the past year with positive experiences and feedback from students. It provides a natural and sometimes much-needed break during the class, while also serving as a valuable feedback tool to assess whether participants have achieved the ILOs. In the beginning, I experienced some stressed about whether I could make it work, however, the Socrative format is user-friendly, both in terms of creating, conducting, and evaluating the quiz. Currently, I have only used it in a format with multiple-choice and true/false options, but I see potential for using it in various other ways in the future.

The Delphi evaluation in the structured form with post-it notes has also been a positive experience. Three aspects are particularly noteworthy. First, the participants' experiences appear to be well represented, and conducting evaluations in a plenary setting concerning the most frequently topics allows for further nuanced insights. Additionally, the direct feedback proves highly useful as a base for improvements in subsequent teaching. Lastly, it activates all students, not only the ones with the 'loudest' voice. The latter would also apply to conducting quizzes.

Conclusion and perspectives

In conclusion, teaching methods such as reflection, feedback opportunities, and more interactive teaching methods involving the participants, were found to contribute to higher learning outcomes and enhanced quality of the learning experience as perceived by the participants. Nevertheless, there are some uncertainties concerning the learning objectives in the last half day of the teaching, as the planned setup did not allow for an assessment of the overall outcomes. In the preparation for the upcoming course day, I will explore further evaluation options to ensure optimal learning conditions throughout the day. Additionally, I will reflect on a plan to maintain an appropriate pace that

allows participants to achieve their intended learning outcomes (ILOs) without feeling overwhelmed. If I choose to provide PowerPoint presentations in advance for future sessions, I can ensure that they are of a legible size and easily readable.

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Appendix

Appendix 1.

Rigshospitalet Hjertecentret

Beskrivelse af Hjertecentrets 1-årige uddannelses- og træningsforløb

Centrets 1-årige uddannelses- og træningsforløb for sygeplejersker er en væsentlig strategisk aktivitet i centrets vision for sygeplejen om en professionel praksis med høj faglighed og kvalitet i forebyggelse, pleje, behandling og rehabilitering til patienter – kerneopgaven. En praksis, hvor vi udvikler og yder højt specialiseret sygepleje, og hvor vi er i front på udvalgte områder. Vi arbejder for en praksis med en livsorienteret tilgang med et både fagligt og omsorgsmæssigt perspektiv, hvor patienterne er involveret og inddraget i handlinger og beslutninger, der vedrører den enkelte patients livssituation og sygdom. Det fordrer, at vi har professionelle og kompetente sygeplejersker i alle afsnit og områder.

Intentionen er, at de kliniske projekter, som deltagerne arbejder med før, under og efter uddannelses- og træningsforløbet, får en positiv værdi for patienterne. Vi måler på outcomes og/eller evaluerer på patientoplevelsen. Den kliniske emne/problemstilling, deltagerne skal arbejde med, drøftes og udvælges i samarbejde med den kliniske specialist og afdelingssygeplejersken ca. en til to måneder inden uddannelses- og træningsforløbet påbegyndes. Projektet løtyttes an til et allerede eksisterende projekt i den udstrækning, det er relevant og muligt, eller som en del af et nyt projekt. Relevante projektidéer kan fx opstå på baggrund af centrets tværsnitsstudie. På træningsforløbet arbejder deltagerne projektbaseret med den kliniske problemstilling, og der udarbejdes projektbeskrivelse for det kliniske projekt. Endvidere udarbejdes en skitse (projektplan) til projektbeskrivelsen med teoretiske overvejelser om, hvordan den viden og resultater, som projektet frembringer, kan forankres i det pågældende afsnit. Herunder hvordan personalet i eget afsnit involveres, så det reelt bliver et fælles projekt (se modellen for kompetenceudvikling). Forløbet afsluttes med en fælles fagdag, hvor deltagerne formidler deres arbejde og resultater ved mundtlig præsentation og en poster for sygeplejepersonalet i centret.

Formål og mål for uddannelses- og træningsforløbet

Det overordnede formål for uddannelses- og træningsforløbet er at forbedre den faglige ydelse til patienterne, samtidig med at sygeplejersken opnår nye og ønskede kompetencer. Det forløber i to spor, hvor det ene spor retter sig mod et klinisk projekt, og det andet spor retter sig mod at styrke sygeplejerskernes organisatoriske kompetencer til at lede mindre forandringsprocesser og implementere den viden, projektet frembringer. I begge spor er der fokus på at styrke kompetenceelementer som: evnen til at forholde sig kritisk til egen praksis, faglig og videnskabelig argumentation, kompetence til refleksion, evne og vilje til handling samt analytiske og praktiske kompetencer til at gøre dét, de lærer. Dette sker i tæt samarbejde med den kliniske sygeplejespecialist eller ph.d.-studerende, som er projektansvarlig.

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Målet er, at deltagerne:

- videreudvikler deres analytiske kompetencer til at identificere kliniske problemstillinger og indhente og kritisk vurdere den nyeste viden inden for det pågældende felt.
- udvikler kompetencer til at formulere undersøgelsesformål, indsamle og opgøre data om egen patientgruppe.
- udvikler kompetencer til at anvende denne viden i eget afsnit og formidle viden til patienter og kollegaer
- styrker deres evne til at reflektere over egen praksis og argumentere fagligt og videnskabeligt for valg af kliniske beslutninger.
- kender og anvender metode til forskning og kvalitetsudvikling.
- får øget indsigt i metoder til at evaluere projektets effekt for patienten.
- får øget viden om begreber og teorier i sygeplejen - og deres betydning for kvaliteten for patienterne.
- får viden om begreber og teorier til analyse, forandringsstrategier, læreprocesser og pædagogiske aktiviteter, der fremmer forankring af den viden og de resultater projektet frembringer.
- etablerer netværk med mulighed for at diskutere, udveksle og drage nytte af hinandens personlige og faglige viden, erfaringer og ressourcer under træningsforløbet.

Deltagere

Deltagerne er sygeplejersker, som afdelingssygeplejersken og de(n) kliniske specialist(er) ønsker at kvalificere til at kunne indgå i udviklingsarbejde og fx varetage ansvaret for kvaliteten af sygeplejen inden for et specifikt område eller deltage i klinisk udviklings- og forskningsarbejde ledet af den kliniske sygeplejespecialist. Deltagerne skal desuden have lyst og evne det 1-årige uddannelses- og træningsforløb. Prioritering til uddannelsen sker i samråd mellem den kliniske specialist og afdelingssygeplejersken.

Uddannelsen forløber over et år med følgende fordeling:

- 136 konfrontationstimer.
- 18 kursusdage og 16 timers individuel vejledning i forbindelse med projektbeskrivelse/ gennemførelse af projekt. Undervisere og vejledere er sygeplejersker med ph.d., kandidat eller masteruddannelse.
- 6 timers litteratursøgning, 4 timers PowerPoint kursus og 4 timers undervisning i postgradatbejdelse.
- 116 timer til gennemførelse af eget projekt inklusive udarbejdelse af projektbeskrivelse på 5-12 A4-sider. Minimum 30 timer foregår i direkte samarbejde med vejleder.
- Projektet præsenteres med skriftligt oplæg på max. 12 sider.

Indhold

Patientperspektiv og patientinddragelse
Udvalgte sygeplejeteorier, begreber og betydningen af teoretiske perspektiver for kvaliteten i pleje og behandling
Vidensformer i de kliniske beslutningsprocesser – den pædagogiske refleksionsmodel
Kvalitetsudvikling – anvendelse af eksisterende forskning

- Metode til kvalitetsudvikling
- Evidensbaseret sundhedsvæsen
- Baseline

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- Litteratursøgning
- Udarbejdelse af abstract, poster og PowerPoint

Forskningstyper og metoder

- Videnskabelighed og videnskabsteoretiske overvejelser
- Teoretisk referenceramme
- Kvalitative og kvantitative metoder
- Etik
- Problemstillingen bestemmer metoden – valg af metode
- Dataindsamling, analyser, resultater/fortolkning, validitet, reliabilitet, fejlkilder, statistiske grundbegreber, populationsstørrelser, måleskalaer og spørgeteknikker

Læring, læreprocesser og forankring af viden

- Teori og begreber til analyse som afsæt for en ændringsproces
- Forandringsstrategier, aktiviteter og metoder

Metode

Projektmetoden: Udgangspunkt i den kliniske problemstilling med udarbejdelse af projektplan. Undervisning med efterfølgende grupperefleksioner og øvelser.
Analyse og vurdering af forskningsartikler i forhold til forskningsresultaternes anvendelighed for klinisk praksis.
Vejledning.
Præsentation i plenum af eget projekt i grupper af 4-5 kursister med henblik på feedback

Vejledning i og ledelse af projekter

Centrets kliniske sygeplejespecialister eller ph.d.-studerende fungerer som vejledere for de sygeplejersker, der deltager. Kursist og vejleder gennemfører projektet i fællesskab. Vejleder er ansvarlig for projektet eller af det overordnede udviklings-/forskningsarbejde, som projektet indgår i.

Kursusdeltagerne og deres vejleder modtager feedback af hovedunderviseren ved de præsentationer i plenum, som kursisten gennemfører. Dette foregår i grupper, hvor fx metode eller emne er beslægtet.

Afdelingssygeplejersker, kliniske sygeplejespecialister og ph.d.-studerende modtager vejledning af hoved underviser Der er afsat tre møder til vejledning. Herudover kan der planlægges yderligere vejledning efter behov og aftale.

Bedømmelse

Projektet præsenteres ved afslutningen, og projektopgaven afleveres til kursusleder, som godkender denne.

ECTS point

Uddannelses- og udviklingsforløbet er vurderet til 18 ECTS-point ud fra Bekendtgørelse for de Sundhedsvidenskabelige uddannelser på Diplomniveau.

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Appendix 2.

socrative

Name
Date

Kvantitativ metode og variable

Score

1. Hvilke overordnede kvantitative metoder eksisterer
   - (A) Eksperimentelle og observationelle
   - (B) Kvalitative interview undersøgelser
   - (C) Fokusgruppe interview
   - (D) Randomiserede kontrollerede forsøg

2. Kohortestudier kan være både fremadskuende og bagudskuende
   - (T) True
   - (F) False

3. HVilke kategopriske variable findes
   - (A) kontinuerte, ordinale og nominale
   - (B) Binære og kontinuerte
   - (C) binære, nominale og ordinale
   - (D) kontinuerte og nominale

4. Køn er en kontinuert variabel
   - (T) True
   - (F) False

5. median og mean er det samme
   - (T) True
   - (F) False

6. Hvad er standard deviation (SD)
   - (A) standardiseret mål for en længde
   - (B) spredningen over midten
   - (C) viser hvor meget data spreder sig fra mean
   - (D) standardiseret mål for en bredde

7. Randomiserede forsøg er kendetegnet ved
   - (A) at deltagerne i studiet er udvalgt via computer
   - (B) at det som deltagerne udsættes for tildeles ved lodtrækning
   - (C) at forskerne har indflydelse på hvad deltagerne udsættes for
   - (D) at forskerne ingen indflydelse har på hvad deltagerne udsættes for

Appendix 3.

socrative

Kvantitativ metode og variable 7 Questions

1. Hvilke overordnede kvantitative metoder eksisterer
   - A Eksperimentelle og observationelle
   - B Kvalitative interview undersøgelser
   - C Fokusgruppe interview
   - D Randomiserede kontrollerede forsøg

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2. Kohortestudier er fremadskuende
   - True
   - F False

3. HVilke ketegopriske variable findes
   - A kontinuerte, ordinale og nominale
   - B Binære og kontinuerte
   - C binære, nominale og ordinale
   - D kontinuerte og nominale

4. Køn er en kontinuert variabel
   - True
   - F False

5. median og mean er det samme
   - T True
   - False

6. Hvad er standard deviation (SD)
   - A standardiseret mål for en længde
   - B spredningen over midten
   - C viser hvor meget data spreder sig fra mean
   - D standardiseret mål for en bredde

7. Randomiserede forsøg er kendetegnet ved

2/11 A at deltagerne i studiet er udvalgt via computer

9/11 B at det som deltagerne udsættes for tildeles ved lodtrækning

5/11 C at forskerne har indflydelse på hvad deltagerne udsættes for

3/11 D at forskerne ingen indflydelse har på hvad deltagerne udsættes for