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Research Article

Calculating the Notional Learning Hours (NLH) for Final Year Medical Students in a Clinical Surgery Clerkship Course

Gamal EHA EL Shallaly*, Nausheen Saeed, and Sathyanarayan Rao

Department of Surgery, College of Medicine and Health Sciences (COMHS), National University (NU), Sohar, Sultanate of Oman

Abstract

Background: The main objective of this study is to design a method to calculate the notional learning hours (NLH) of final-year medical students doing a surgical clerkship course, as current methods are based only on assumptions. Secondary objectives include derivation of the Oman Qualification Framework (OQF) credits and setting a benchmark of NLH calculation in clinical courses.

Methods: This is an observational cross-sectional study which uses quantitative methods to estimate students' NLH. A questionnaire was designed and filled in by final-year medical students at the end of their surgical rotation. Ethical clearance was obtained. Data were uploaded and analyzed using the SPSS 25. The NLH was then calculated and mapped onto the OQF template.

Results: Ninety-seven students participated in the study. Students spent an average of 1.20 hrs/day studying for their clinical sessions and 2.86/day studying for their theory sessions. The mean weekend hours of study on Friday and Saturday were 3.1 and 3.2 hrs, respectively. The average preparation for the end rotation and the final graduating (MD) exams were 9.7 and 10.4 hrs, respectively. We calculated the NLH of our students by adding the above data to the contact teaching hours from our course timetable. We compared our results with medical schools worldwide.

Conclusion: The NLH of our surgical clerkship students was calculated and subsequently the OQF credits were derived. Our method is based on real-life students' study hours and not on unproven assumptions. It could be used as a guide by other clinical clerkship courses.

Keywords: notional learning hours, credit hours, Oman Authority for Academic Accreditation and Quality Assurance of Education (OAAAQA), Oman Qualification Framework (OQF), students' workload, self-study, medical students, surgical clerkship

Corresponding Author: Gamal EHA EL Shallaly; email: gamalelshallaly@nu.edu.om

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1. Introduction

Credit units/hours are used to standardize course programs and make them comparable to other university programs. In addition, they create common grounds for the transfer of credits among different universities [1]. Credit hours (CHs) were created in 1906 by the Carnegie Foundation and were called the Carnegie unit. They were meant to measure teacher productivity and were used to pay faculty pensions**.** A CH is based on contact hours of teaching (instruction) and is defined as 'one hour of classroom instructions per week, in a 14–16 week course/semester' [2, 3].

However, over time, there has been a paradigm shift in higher education from a classical time-based to outcome-based education (OBE). In addition, the focus has shifted from teacher-led education to student-led education [1, 4]. As a result, the standard practice of CH-based calculation of contact hours has become ineffective to measure student learning [5]. Instead, the concept of notional learning hours (NLH) has gained increasing importance. NLH is defined as the volume of work *students* spend to achieve the *learning outcomes* of a course or module [1, 4, 6]. It thus reflects the students' workload [1].

In many universities, new CHs are currently calculated by adding the students' workload (based on NLH) to the contact hours rather than from the teaching contact hours alone.

Other reasons why the classical CHs based on teaching contact hours should be changed include the variability of teaching methods and students' characteristics, both of which potentially impact learning outcomes. Methods of teaching are variable, such as face-to-face versus online teaching (as employed by many universities during the COVID-19 pandemic), flip classrooms, and distance learning. The variation in student characteristics includes their learning styles and stress management skills. These complexities highlight the significance of re-examining the current system, broadening the definition of student workload beyond contact hours, and including students' perception to devise a clear and transparent system [5].

Taking all of the above into consideration, the Oman Authority for Academic Accreditation and Quality Assurance of Education (OAAAQA) has recently introduced a framework termed the Oman Qualification Framework (OQF) which is defined as 'an instrument to describe; compare; and classify qualifications from all sectors of education and training in Oman' [6].

The OQF uses two measures for the listing and alignment of qualifications offered by Omani and foreign educational institutes. These are the OQF level and the OQF Credit. The OQF level measures the complexity whereas the OQF credit measures the volume of learning. The OQF Credit is defined as "a numerical indicator of the volume of learning, awarded for the achievement of all the Learning Outcomes of a unit, module or course and/or qualification, expressed in either OQF Credit Points or OQF Credit Hours." Both OQF Credit Points (CPs) and OQF CHs are based on NLH which are defined as "the *volume* of learning estimated to be required by a typical learner at a specified level to achieve the *learning outcomes* of the units, modules or courses that comprise a qualification" [6].

NLH is measured by adding the number of contact hours (time-tabled study hours/or instructional time) to students' out of class/hospital self-study time and assessment time. Self-study time includes students' self-learning time, preparation

for seminars, and assignments and time for reviewing for assessments [7].

The OQF considers 42 NLH equal to one OQF CH and 10 NLH equal to one OQF CP. Calculating the NLH is, therefore, an important step to deduce both the OQF CPs and CHs.

This is based on the *assumption* that a course is offered for a semester of 14 weeks. One OQF CH comprises a combination of activities such as: (i) 1-hr class contact time and 2 hrs of self-study/learning time per week (3 × 14 wks = 42) or (ii) 2 hrs of laboratory/clinical work and 1 hr of self-study per week (3 × 14 wks = 42), or (iii) 3 hrs of self-study/week (3 × 14 wks = 42).

The justification for designing a new method for calculating the NLH can be summarized as follows:

(i) Current methods of calculating NLH are based on assumptions. These assumptions are made by educators and not students.

(ii) Various universities use different methods to calculate NLH and CH and the literature contains wide and varied descriptions, as well as citing problems, with such calculations [1, 4, 7, 8].

(iii) Medical schools in general have a different system than that provided by the OQF template. This is because the OQF template describes a four-year bachelor program, whereas a conventional medical program takes more than four years to complete. Our university adopts a six-year Doctor of Medicine (MD) program with a total of 254 CHs based on contact hours. The OQF introduction of the NLH system will change our calculation of CHs.

Our department of surgery, therefore, set out to design a method to calculate the NLH that considered both the program teaching timetable (instructional time) and the students' accounts of self-study time. This quantitative method is different from the qualitative methods used in literature to evaluate students' perception [9]. In addition, we believe that direct questioning of students should be more reliable than simply depending on educators' estimation of students' self-study time. We aim to get as close as possible to the real workload (notional hours) of our medical students. We also aim to present a real-life student-based guide for calculating NLH for clinical courses, which as far as we know is lacking.

1.1. Objectives

(i) To calculate the NLH of final-year (MD6) medical students doing the surgical clerkship course at the College of Medicine and Health Sciences (COMHS), National University (NU).

(ii) To deduce the OQF CPs and CHs based on the students' NLH.

(iii) To set a simple student-based calculation method of NLH in clinical courses.

2. Materials and Methods

This is a cross-sectional observational study using a convenience sampling method. The study was conducted in the only private medical school in Oman with an outcome-based curriculum.

Final-year medical students in (MD6) surgery clerkship rotation at (COMHS, NU), in the year 2022–2023, were invited to participate in the study. Participation was voluntary and anonymous. A questionnaire about time devoted to self-study was prepared and given to the students to fill in manually. Students were asked about the average hours they study per day, to review and prepare for their clinical rounds and theoretical sessions. Questions were also asked about their average study time over the weekends, and the average study time per day to prepare for the various assessments and examinations. We piloted the

questionnaire on the first cohort in the rotation (about 20 students). Consequently, we developed it further and applied it to the following groups.

Ninety-seven out of a cohort of the one-hundred and twenty-nine final-year students responded (75% response rate). Data were uploaded and analyzed using the SPSS (IBM version 25). The means and standard deviation of the hours of study were calculated. The study considered the NLH of our six-week course including both teaching and assessment days and times.

2.1. Method of calculation

We calculated the NLH per day by adding both contact teaching hours (based on our course program timetable/schedule) and the students' self-study/preparation time (based on our study). The daily program (timetabled instructional teaching) consists of 4 hrs of clinical exposure (in the hospital or health center), followed by 3 hrs of theoretical sessions (such as student-led seminars, interactive faculty lectures, student-directed learning, and so on). These theoretical sessions take place on the college premises. Figure **1** is a snapshot of our teaching program.

We used the SPSS program to calculate the mean self-study time using the data given by the students.

We added this self-study time to our time-tabled teaching hours to get the workload or NLH per day. This NLH/day was multiplied by five to get NLH per week. We added the weekend students' workload (taken from the study) and 1 hr of on-call per week to get the total NLH per week.

We multiplied the NLH/week by five weeks. To this, we added the activity of the sixth week, which contains two assessments days, and the calculations are slightly different.

In our six-week surgery course, the last (sixth) week comprises of three days of regular teaching and two days of assessment. Therefore, the contact hours as well as the assessment time and students' self-study hours have all been added. The final MD examination which takes place after finishing the sixth week was also accounted for. Adding all these together, we were able to calculate the total NLH.

We used the formula provided by the OQF document to calculate the CP and CH by dividing the NLH by 10 and 42, respectively. Finally, we used this data to complete the OQF template provided by the OQF authority.

3. Results

Ninety-seven students participated in the study. The mean and standard deviation of the self-study time (learning/preparation hours) of these students were calculated using the SPSS program (Table 1).

The mean self-study hours per day for clinical and theory teaching were 1.2 hrs (0.9) and 2.8 hrs (1.4), respectively. The mean self-study hours per day is therefore 4 hrs. This is added to the contact hours of clinical (4 hrs) and theory (3 hrs) teaching, taken from the teaching program. This makes an average of 11 NLH per day (4 + 4 + 3). We multiply this by 5 days to give 55 NLH per week excluding weekend study and additional hospital activities.

Most of the students (79%) study over the weekend. The mean self-study hours on the weekend were 3.1 (2.6) and 3.2 (2.5) hrs for Friday and Saturday, respectively. This gives an average of 6.3 hrs of study over the weekend. Students spend 1 hr on-call for hospital duty per week. The total NLH/week is therefore (55 + 6.3 + 1) 62.3 (Table 2).

If we want to calculate the self-study hours over a seven-day week, we will add the working day

SURGERY Group 'E' – teaching schedule from 6th Sep. 2022 to 13th Oct. 2022

Date	8 to 10AM Rounds / Bedside	10.30 - 12PM Bedside	8AM to 12PM Surgery OPD	8AM to 12PM Surgery OPD / OT	6PM - 9 PM Call	Skills Lab 9.00AM to 11.30AM	Student-Led-Seminar (SLD) 01.00PM to 02.30PM			Clinical cases discussion 02.30PM to 4.00PM		
							Name of SLD	Student	Faculty	Clinical Case	Student	Faculty
08/09/22	Gr.3	Gr. 3	Gr. 1B Plastic Surg OPD	Gr. 1A 2 Day OT 2 Urology OT		Gr.2, Mod 1 Dr. John	Acute Intestinal obstruction		Dr. R			
11/09/22	Gr.1	Gr. 1	Gr. 2A Surgery OPD	Gr. 2B Surg OT 12 &14	Gr. 3	Gr.3, Mod 1 Dr. John / Dr. Gamal	Benign diseases of the Breast	Student A	Dr. N	Examination of a swelling and Ulcer		Dr. Rao
12/09/22	Gr.2	Gr. 2,	Gr. 3B Surgery OPD	Gr. 3A Podiatry OPD	Gr. 1	Gr.1, Mod 1 Dr. J	**Hot Case**					
13/09/22	Gr.3	Gr. 3	Gr. 1A Surgery OPD	Gr. 1B Surgery OT 1 & 3	Gr. 2	Gr.2, Mod 3 Dr. G	Malignant diseases of the Breast	Student B	Dr. N	Breast lump	Student Y	Dr. Naushen
14/09/22	Gr.1	Gr. 1	Gr. 2B Surgery OPD	Gr. 2A Surgery OT 11 & 7 / Uro OPD	Gr.3	Gr.3, Mod 3 Dr. G	Post Operative Care and Complications + Day surg	Student C	Dr. R	**SDL**		
15/09/22	Gr.2	Gr. 2	Gr. 3A Plastic Surg OPD	Gr. 3B 18 & 21 Day OT 24&23Urology OT		Gr.1, Mod 3 Dr. G	Varicose veins and DVT	Student D	Dr. M	Weekly test		
18/09/22	Gr.	Gr. 3	Gr. 1B Surgery OPD	Gr. 1A Surgery OT 22 & 16	Gr.2	Gr.2, Mod 2 Dr. R	The biliary tree with d/d of Obstructive jaundice	Student E	Dr. G	Lateral neck swellings – Branchial cyst, thyroglossal cyst, cystic hygr and lymph		Dr. Naushen
19/09/22	Gr.1	Gr. 1 Vascular Surgery	Gr. 2A Surgery OPD	Gr. 2B Podiatry OPD	Gr. 3	Gr.3, Mod 2 Dr. R	Renal, Ureteric stones, Hydro nephrosis	Student F	Urology Dr. M	**Evidence Based Medicine**		Dr. Naushen
20/09/22	Gr.2	Gr. 2	Gr. 3B Surgery OPD	Gr. 3A Surgery OT 5 & 10	Gr. 1	Gr.1, Mod 2 Dr. R	Thyroid malignancies	Student G	Dr. J	Obstructive jaundice benign and malignant		Dr. Gamal
21/09/22	Gr. 3	Gr. 3	Gr. 1A Surgery OPD	Gr. 1B Surgery OT 1 & 3 / Uro OPD	Gr. 2	Gr.2MOCC1 Dr. R	Colorectal cancers & Lower GI bleeding	Student H	Dr. GI	Thyroid swelling solitary nodule	Student Z	Dr. John
22/09/22	Gr.1	Gr. 1	Gr. 2B Plastic Surg OPD	Gr. 2A 6 &13 Day OT 11 & 7Urology OT		Gr.3MOCC1 Dr N	Peripheral vascular diseases, aortic aneurysm	Student I	Dr. M	Weekly test		
25/09/22	Gr.2	Gr. 2, Surgery	Gr. 3A Surgery OPD	Gr. 3B Surgery OT 17 & 18	Gr. 1	Gr. 1 MOC1 Dr. G	Polytrauma – Trauma of chest and abdomen – Mx	Student J	Dr. G	**X - Rays**		Dr. Rao
26/09/22	Gr.3	Gr. 3 Surgery	Gr. 1B Surgery OPD	Gr. 1A Podiatry OPD	Gr. 2	Gr. 2 ESWL	Disorders of Prostate, urinary bladder & urethra	Student K	Urology Dr. E	**Integrated session with anatomy**		
27/09/22	Gr.1	Gr. 1 Surgery	Gr. 2A Surgery OPD	Gr. 2B Surgery OT 15 & 8	Gr. 3	Gr.3 Mod4 Dr. N	Acute Pancreatitis	Student L	Dr. N	Surgical appliances		Dr. Gamal
28/09/22	Gr.2	Gr. 2 Surgery	Gr. 3B Surgery OPD	Gr. 3A Surgery OT 19 &20 Urology OPD	Gr. 1	Gr.1 Mod 4 Dr. N	Chronic pancreatitis and Carcinoma of pancreas	Student M	Dr. N	IV fluids and Lab reports		Dr. Rao

Figure 1: Program schedule.

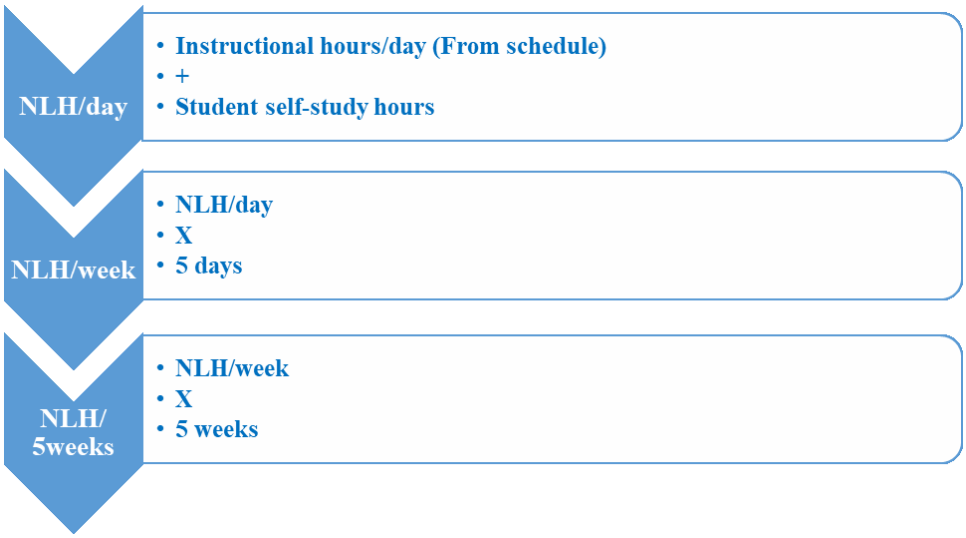

Figure 2: Flow chart for calculating NLH for five weeks.

plus the weekend self-study hours which are 4 + 6.3 hrs equals 10.3 hrs/wk. We will use this figure to compare with literature in the Discussion section.

We calculated the NLH for five weeks of the course by multiplying by five: (5 x 62.3) = 311.5.

To the above, we added the NLH of the sixth week of the course which comprises three teaching contact days (3 x 11 hrs = 33 hrs) and two assessment days (2 x 2 hrs = 4 hrs), giving a total of 37 NLH for the sixth week alone.

The mean study (learning/preparation) time spent by the average student on revising for the end rotation and final MD exams were 9.7 (3.3) and

Table 1: The mean and standard deviation of the self-study hours of 97 medical students.

Self-study Hrs/day	Mean (Standard deviation) Hrs
For clinical sessions	1.2 (0.9)
For theoretical sessions	2.8 (1.4)
Friday	3.1 (2.6)
Saturday	3.2 (2.5)
Preparation for end rotation exam	9.7 (3.3)
Preparation for the final MD exam	10.4 (3.5)

Table 2: Notional learning hours and derivation of OQF credit points and credit hours according to the program schedule used in NU.

A. Program: Contact hrs/day	B. Student's study-prep hrs/day	Notional learning hours NLH (A + B)
Clinical: 4	1.2	5.2
Theoretical: 3	2.8	5.8
Notional hrs/day		(5.2 + 5.8) = 11
NH/wk (5 working days)	11 × 5	55
Other activities/wk:		
On-call hospital rounds	1	1
Weekend study/prep	Fri (3.1) + Sat (3.2)	6.3
Total NLH/wk	(55 + 1 + 6.3)	62.3
NH in 5 wks Including 4 hrs MiniCex1 (formative) and Mini Cex 2 (summative) assessments	5 × 62.3	311.5
3 days teaching in the 6th week	3 × 11	33
Assessment: ERE 2 days: (4 + 3) + (4 + 1.5) + MD (OSCE 4 + 1.5 MCQs)	7 + 5.5 +5.5	18
2 days student's prep for ERE and MD final exam (9.7 hrs/day)	9.7 × 2 + 10.4	29.8
Assessment: MD		
Total NH	(311.5 + 33+ 18 + 29.8)	392.3
OQF credit points	392/10 = 39.2	39
OQF credit hours	392/42 = 9. 3	9

ERE: end of rotation exam; MD: final MD exam.

10.4 (3.6) hrs, respectively. This too is added to the NLH calculated above.

The total NLH was calculated at 380 hrs.

According to the OQF, 10 NLH gives one CP and 42 NLH gives one CH.

Hence, our six-week surgery course has 38 OQF CPs and 9 OQF CHs.

Based on the above study, we were able to complete the OQF template of NLH with real students' self-study data (Table 3).

4. Discussion

There is no globally agreed-upon system to calculate CHs or units. Different methods are used in the USA, UK, and Europe [1, 8]. For example, in

Table 3: OQF template.

Activity		Notional learning hours
Contact hours	Lectures/Class/Seminars/Tutorials (3 x 5 days x 5 wks) +(3 x 3) 6th wk	84
	Practical/Laboratory/Clinical (4 x 5 x 5) 5 wks + (4 x 3) 6th wk + 1 hr on call x 5	117
	Field work	NA
Assessment: ERE 2 days (12.5) + MD (5.5)		18
Independent learning, including research and revision for assessment: weekend (4 x 5 x 5) + revision (4 x 3)		112
Other (specify): weekend self-study (6.3 x 5 wks) + review for exams (ERE and MD) 9.7 x 2 + 10.4		61.3
Total notional learning hours		392.3
Use one system. Do not use both	Proposed number of OQF credit points	39
	Proposed number of OQF credit hours	9

the USA, a credit unit comprises of one academic hour of instructional time and two academic hours of self-preparation [1]. The sum of these is called notional time, which is the time required by the student to successfully complete the course. In the UK, one study credit is calculated for 10 notional hours. This means that 100 notional hours will be counted as 10 study credit units. The latter is similar to the OQF CP mentioned above. The European credit transfer and accumulation system (ECTS), on the other hand, considers one ECTS credit equal to 2 UK credits. It includes not only the instructional and self-preparation time (as in the UK), but also other academic activities such as examinations and students' preparation for exams.

These differences are even more evident in medical MD programs across the globe, and even within the same country. For example, in the UK, medical schools differ in duration, format, and contents taught [8]. In the USA, the West Virginia School of Medicine policy statement states that one CH of 'guided instruction' is equivalent to one contact hour of guided instruction per week for 15 wks, totaling to 15 contact hours. For each CH, students should expect 2 hrs of 'unguided study time' including reading, independent or group study, self-directed learning, and preparation for assessments [10]. The University of Michigan medical school program includes approximately contact time of 18–22 hrs/wk. Students complete 3 hrs out-of-class time per hour of contact instructions. In their clinical years, the contact time is even greater, ranging from 30 to 80 hrs/wk, including experiential learning and patient care [11].

Because of all the above, and to keep in line with the global development of OBE, the OAAAQA has recently introduced the OQF for the listing and alignment of qualifications offered by Omani and foreign educational institutes, respectively. NLH data are lacking considering medical schools and clinical clerkship.

The NLH is difficult to calculate, and problems are usually encountered at the beginning [7]. This is because it is a newly introduced concept and there are no previous clinical examples.

According to our study, medical students in our surgical clerkship spend an average of 4 hrs/day in self-study reviewing their clinical (1.2 hrs) and theoretical teaching (2.8 hrs). Over the weekend, most (79%) students self-study for 6.3 hrs on

average. This means that they study on average 26.3 hrs/wk (= 4 x 5 + 6.3).

The time devoted to self-study has been shown by many authorities to be dependent on both the curriculum and the students' characteristics and their learning styles [12–14]. Student characteristics were found to be a greater source of variability than the curriculum or clerkship [12, 15]. However, the same literature shows great variations between the average self-study hours devoted to each clerkship. Our average of 26.3 hrs of self-study per week is similar to the findings of Worley *et al.* [16]. It is much higher than the highest achieved by students in the medicine rotation (9.8 hrs) in a medical school in Portugal [12]. It is also higher than other studies by Dolmans *et al.* (8 hrs), and Philp *et al.* (6.2 hrs) [17, 18].

Our study has shown that our medical students spend about 1 hr on average reviewing their hospital teaching of 4 hrs (1:4 ratio), whereas they require almost 3 hrs to review the 3 hrs of theoretical teaching (1:1 ratio). This is not surprising since the essence of clinical learning in medicine occurs in the hospital or health facility. They require less time than they require after theoretical teaching. This finding also contradicts the idea that students require 2 hrs of self-study for 1 hr of lecture. We, as well as another authority, found that this century-old assumption of the Carnegie unit as a measure of class time does not reflect the real time spent by medical students on self-study [19]. We pose the question of whether it is still relevant today?

Also, we have not come across a study that focuses on the difference between clinical and theoretical self-study times. Further studies should investigate clinical and theoretical self-study times in clerkships other than surgery before we come to any conclusions.

Our study has also shown that:

- Quantitative estimate of students of their own self-study time is more realistic than educator estimation, particularly in the clinical/surgical clerkship.
- It is easy to calculate the NLH per day then multiply this by the number of weeks and adding assessment time. This is easier than compiling time separately and adding it.
- In agreement with Van der Horst and Barbosa, we believe that the NLH should be calculated for each clinical clerkship [4, 12]. No general formula is suitable or applicable to all modules. This is because different departments and universities use different program schedules. Nevertheless, the most important factor is the students' estimate of their actual self-study time.

5. Strength and Limitations

This is an original study on NLH calculations of medical students, where data is lacking. It sets a benchmark for calculations based on actual students' estimation of their workload and, according to Barbosa *et al.*'s assertion that 32 students are needed to achieve reliability for clerkship self-study time reporting [12], the data collected from 97 students in our study are demonstrative of its reliability.

The limitations of the study revolve around the timing of the questionnaire administration. The questionnaire was given before students' final MD exam. Hence the estimation of the self-study time for the final MD depended on students' prior perception and anticipation, rather than the actual real time spent. The MD final exam takes place after completion of the final year. A period of 4–6 wks may elapse between the last rotation and the MD exam. Further studies should look into this period.

Administering the questionnaire at or immediately after the MD exam could be more accurate in determining the real-life students' self-study time.

6. Conclusion

We present a simple method for calculating the NLH, based on students' real-life self-study data. From the NLH, OQF CPs and CHs were deduced. This method can be used by other clinical clerkships and courses, based on their own program schedules. We compared our students' NLH with others in the literature. More research is warranted in this evolving area to create a robust and transparent system that can effectively measure and address the learning needs of future physicians.

Declarations

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Ethical Considerations

Ethical clearance was obtained from the ethics and biosafety committee (EBC) at the COMHS (Registration no.: NU/COMHS/ EBC002/2023).

Competing Interests

The authors declare no conflicting interests.

Availability of Data and Material

The authors are happy to provide raw data if requested.

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The study was self-funded.

Abbreviations and Symbols

NLH: Notional learning hours

OQF: Oman Qualification Framework

MD: Medical Doctorate

OAAAQA: Oman Authority for Academic Accreditation and Quality Assurance of education

OBE: Outcome-based education

CP: Credit point

CH: Credit hour

EBC: Ethics and Biosafety Committee

COMHS: College of Medicine and Health Sciences

NU: National University

MD6: Final-year medical students at COMHS, NU

SPSS: Statistical Package for the Social Sciences

Mini Cex: Mini clinical examination

ERE: End rotation examination

ECTS: European Credit Transfer and Accumulation System

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