

**Original Article**

**A STUDY TO EXPLORE LEARNING STYLE PREFERENCES OF PHARMACY STUDENTS WITH REGARD TO PHARMACEUTICAL CALCULATIONS**

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**ABSTRACT**

**Objective:** Pharmaceutical calculations are an essential aspect of learning for pharmacy students in order to avoid drug dose errors and maintain patient safety in future practice. Learning styles influence how lecturers approach the teaching-learning process. So far no specific learning preference is believed to be most appropriate for the pharmacy curricular; however certain learning styles are favoured by students as they improve their understanding of course material, knowledge and performance.

**Methods:** 148 Master of pharmacy participants from the second and third year were given a questionnaire to complete during a compulsory Individual Readiness Assurance Test session. Participants were restricted to just one option.

**Results:** Workshops with a tutor was the most selected (36%) followed by 25% of participants favouring formative assessments, 28% selected workbooks alone, 37% for whole-class lecturers and videos option was the least selected. Reasons for the most and least preferred learning styles were highlighted and separated into advantages and disadvantages using themes. In the knowledge test; 92% of participants selected "unsure" or "didn't know" the answer, 29% had a partially correct answer and 19% selected incorrect answers.

The overall order of ranking arose in regards to the most beneficial learning style which enhances performance. The responses revealed a variety of advantages and disadvantages which were reflected between year groups and similar to views obtained from recent literature. Students reflected a lack of understanding on extemporaneous preparation (EPs) terms used in pharmaceutical compounding practices, thus the university should consider addressing the lack of awareness and consider the best teaching-learning style in doing so.

**Conclusion:** Overall the findings suggested that the sample students have similar views on the learning styles used to deliver pharmaceutical calculations on their academic performance to that expressed by the authors from recent published literature.

**Keywords:** Pharmaceutical calculations, Learning styles, University, Preference, Academic performance

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**INTRODUCTION**

The use of pharmaceutical calculations (PCs) in practice is fundamental to patient safety [1, 2]. Pharmacists must calculate doses tailored for specific patients, avoiding both toxic and sub-therapeutic doses for any route of administration [3].

The General Pharmaceutical Council (GPhC) requires pharmacy graduates to pass a registration examination in which one part is solely based on PCs. Candidates must achieve 70% to qualify [4]. Regular practice of various PCs throughout the course will build stable background at university [5].

In 2014, the University of Wolverhampton (UoW) altered their course structure. The new structure includes teaching the mathematical skills required, plus multiple opportunities within each academic year to practise, improve and evaluate PC skills [6].

A variety of learning styles and support materials are used by universities to improve teaching and academic performance [7]. To date, no specific delivery style has been identified as the most appropriate for the pharmacy curriculum<sup>8</sup>, but certain styles have been preferred as they appear to improve students' understanding of course material, overall knowledge and performance. This means students achieve more confidence in carrying out calculations, [9-11] to avoid drug dose errors and promote patient safety [2, 12].

One method of teaching PCs is via an e-learning, non-credit based module (topic tutorials, work booklets and self-assessments [13]. Students are enabled to progress at their own pace, in their own comfort zones. They gain direct feedback, increasing their understanding of the sub-topics [14]. However, students find some topics within the module less relevant to them or that tutorials to

take up too much time and the degree of ease/difficulty is not uniform. Also, students who are less computer-literate are discouraged, [13]. Van [15] claims students attending traditional face to face lectures greatly improved in performance when compared to e-learning modules.

The standard lecture format at UoW covers a presentation, made available 24 h before a timetabled session [16]. Both lecturers and students reportedly enjoy this style of teaching; benefits include interaction with lecturers' face to face [17], team work and class discussions amongst students<sup>5</sup>. However, Fike [17] reported students' attendance declined around assessments due dates (80% or less), but no significant difference in grades was identified between students who attended lectures and those who did not. Preszler and Hoopes [10] claimed that students prefer attending more valuable smaller tutorials compared to weekly lectures.

Interactive workshops comprised of small groups of students' solving practice-scenario challenging questions. Their workshops were designed to improve students' skills to an appropriate level of understanding, application and competence [10]. According to Batchelor [5] more than 50% of students learn better in workshops compared to lectures. Further, the use of team work within these sessions increased scores >20% compared to individual marks [9]. Workshops appear able to improve students' understanding of course materials, making them confident in carrying out calculations [9].

A more recent concept being used to teach PCs is video recordings; a complete presentation is recorded by the lecturer and made available to students to download or simply watch online [16]. In this model, lecturers are able to track student engagement and students are able to revisit concepts multiple times to understand

course material, enhancing learning [16, 18]. Glaister [19] claimed computerised learning was effective at developing knowledge and Karyn [16] claimed higher exam grades were achieved when students used videos. However, students reported being stressed when applying concepts and solving question immediately following intensive video, reporting a perception that extra time was required [16]. Van [15] claimed that although this form of learning had some benefits, traditional didactic lectures were more effective in terms of student achievement.

Another learning style is the use of formative assessments [13, 20]. Students undertake these in a location of their choice, without the use of any materials. They cover a range of topics of varying difficulty [13, 21]. These mini-tests were claimed to improve skills and performance [22] as they assess students' knowledge, retention and the ability to apply concepts [3, 20]. After having completed the exercises, rapid, detailed feedback is received, allowing learning adjustments to be made and also the opportunity of repeated practice [23, 24]. Feedback delivered included solutions with detailed working, and an opportunity to seek one to one support [23, 24]. Gums [22] claimed higher test scores were noted due to this form of individualised feedback, whitensz and Frosch [21] demonstrated that students who take these regular quizzes and assessments experience less stress than they did in the past, when taking summative examinations.

Learning influences how lecturers approach the teaching-learning process [25]. The array of learning styles available have clear benefits and issues. Exposing students to the variety of styles available, provides the opportunity to exercise judgement on how

they prefer to learn<sup>s</sup> and determine which learning style will promote application and competence [26].

The aim of this project was to highlight pharmacy students' preferences of learning styles with respect to PCs.

The three main objectives of this project are:

- To identify and analyse the views of pharmacy students on PC learning styles.
- To analyse the reasoning for their most and least preferred learning styles.
- To capture and determine the advantages and disadvantages of each learning style.

## MATERIALS AND METHODS

### Methods

Two cohorts from the MPharm students at the University of Wolverhampton, Wolverhampton, UK. Students were recruited from second and third year classes (n=168). A self-administered questionnaire was selected as the most appropriate data collection tool. The study was approved by the School of Pharmacy Ethical Review Board. Open-ended and closed-ended questions were used in the questionnaire, to minimise the disadvantages of using one type of question alone. A ranking system was also used to rank preferences over the five currently used learning styles. This allowed participants to avoid selecting all learning styles as most or least preferred assigning a unique value to a learning style [43].

**Table 1: Categorised questions used in the questionnaire**

Types of questions	
Closed-ended	Open-ended
<ul style="list-style-type: none"> <li>- Demographics</li> <li>- Background regarding mathematics grades, most recent PCs grades,</li> <li>- Previously covered sub-topics,</li> <li>- Importance of calculations for the MPharm course and as a future pharmacist,</li> <li>- Self confidence in solving calculations,</li> <li>- The understanding of the expected GPhC pass mark and familiarity of the type of questions set by the GPhC</li> <li>- Regularly relied on resources</li> </ul>	<ul style="list-style-type: none"> <li>- Responses to extemporaneous preparation terms based on traditional pharmaceutical compounding practices</li> <li>- The reasons for the most and last preferred learning styles</li> </ul>

A pilot study was conducted (n=10) using students from year four of the MPharm course. From the study results two main alterations were made in light of the responses. A "Prefer not to say" option was added to questions relating to previous GCSE or A-level mathematics grades as half the students in the pilot refused to answer these questions and also decided not to circle the "Not applicable" option concerning the grade they had obtained in mathematics. Another change was the addition of directions to sets of questions, as it was noticed that students were selecting two or more options where only one was required. Thus, these specific directions restricted students from selecting a number of options and also clarified questions further.

Participants were given a questionnaire containing 22 questions and an information sheet, explaining the reasons to why they have been selected. The questionnaire was handed out before a compulsory Individual Readiness Assurance Test (iRAT) session, maximising

attendance. No unique identifiers were included in the questionnaire and participants were verbally informed that all responses would be anonymous and confidential. They were also informed that there was no obligation to take part in the study. The method was applied to both year groups and all returned questions were recorded and accounted for.

The qualitative data was analysed thematically. The thematic analysis combined similar statements the quantitative data was analysed using tables and graphical charts, where trends in results were simply observed between the year groups. Student responses which were submitted incomplete or completely blank were not included in the final study population.

## RESULTS

From a total of 168 students, 148 students took part in the study, equating to a response rate of 88% (table 2).

**Table 2: Response rate of the study for second and third years**

Category	Year 2	Year 3	Total
Number of students eligible	90	78	168
Number of participants	79	69	148
Drop outs	0	0	0
Response rate (rounded to the nearest whole number)	88%	88%	88%

The results gathered from questions 1-5 are presented in table 3. Of the participants, 93% had completed GCSE mathematics, with 1% opting to not state their grades and 5% reporting taking an

equivalent qualification. In addition, 43% of students also completed A-level mathematics, with 4% opting not to state their grade.

**Table 3: Participants' backgrounds before enrolling on the course**

Category	Available responses	Number of year 2 students	Number of year 3 students	Total Number of students	
Gender	Male	39	41	80	
	Female	40	28	68	
GCSE mathematics grade	A*	4	13	17	
	A	26	28	54	
	B	30	20	50	
	C	13	4	17	
	Prefer not to say	1	1	2	
	Not applicable	5	3	8	
A-level mathematics grade	A*	2	1	3	
	A	1	10	11	
	B	7	16	23	
	C	9	9	18	
	D	4	4	8	
	Below D	1	0	1	
	Prefer not to say	3	3	6	
	Not applicable	52	26	78	
	Pharmaceutical calculation sub-topics covered before learning about them at University	Doses calculation	29	27	56
		Dilutions	23	40	63
Displacement volumes and values		22	34	56	
Concentrations		31	39	70	
Quantities to supply		18	28	46	
Molecular weights		59	58	117	
Using provided formulae		48	43	91	
Infusion rates		6	19	25	
Pharmacokinetics		10	13	23	
Health economics		4	6	10	

The results obtained from questions 6-9 are presented in table 4; 86% of participants felt PCs were vital for the MPharm degree and 85% agreed on the importance of calculations to their future careers. Also, 32% of students felt they either needed more support or lacked confidence in solving PCs compared to the 68% who

generally felt confident or very confident. However, within both year groups, 10% of students scored under 70% in their final examination compared to 87% achieving a comfortable pass rate, possibly due to 52% of students regularly relying on additional text books, 10% on private tuition, 43% on videos and 4% on workbooks.

**Table 4: Responses to questions 6-9**

category	Available responses	Number of year 2 students	Number of year 3 students	Total number of students
Importance of pharmaceutical calculations to MPharm degree	Not important at all	0	2	2
	Somewhat important	0	1	1
	Important	8	3	11
	Very important	16	8	24
	Absolutely essential	55	38	93
Importance of pharmaceutical calculations to future job as a pharmacist	Not important at all	0	0	0
	Somewhat important	4	0	4
	Important	8	7	15
	Very important	14	11	25
	Absolutely essential	53	33	86
Self-confidence at solving pharmaceutical calculation questions	Very confident	10	16	26
	Confident	43	31	74
	Need more support	24	21	45
	Not confident	2	1	3
End-of year pharmaceutical calculations exam score	Can't remember	0	1	1
	Less than 39%	1	1	2
	39-69%	7	5	12
	70%+	69	60	129
	Prefer not to say	2	2	4
Additional resources regularly relied on:	Text books	36	41	77
	Private tuition	7	8	15
	YouTube clips	33	30	63
	Other (Workbooks)	6	0	6

Table 5 reports participants' perception of the pre-registration exam. Generally within both year groups, more than 50% of participants were aware of all the different types of questions set by the GPhC, except for

questions based around estimations of kidney functions and health economics. Also, 65% of students estimated the GPhC examination pass rate at 70% and over, where 6% estimated a pass mark of 50% or under.

**Table 5: Responses to questions 10 and 11**

Category	Available responses	Number of year 2 students	Number of year 3 students	Total number of students
Familiarity of the different type of questions set by the GPhC	Doses and dose regimens	54	54	108
	Dosage and unit conversion	63	53	116
	Estimations of kidney functions	9	8	17
	Displacement volumes and values	43	44	87
	Concentrations	68	54	122
	Dilutions, including concentrated waters	48	45	93
	Molecular weight	54	47	101
	Using provided formulae	41	44	85
	Infusion rates	13	33	46
	pharmacokinetics	19	14	35
	Health economics	3	1	4
	Quantity to supply	39	37	76
	Understanding the pass % mark for the GPhC PC exam	40%	3	1
50%		3	2	5
70%		45	51	96
90-100%		28	15	43

Presented in table 6 are the categorised responses to question 12-19 which were collated and analysed using a thematic approach. Questions 12-19 were included at the request of teaching staff who wished to establish whether students are familiar with some of the key components of CP involving EPs. One hundred participants

chose not to answer questions 12-19 leaving only 48 participants for this specific section.

Tables 7 and 8 are thematic analysis students' responses about the reasons of the most and least preferred learning styles.

**Table 6: Responses to questions 12-19**

Questions	Themes derived	Responses (%) year 2 students	Responses (%) year 3 students	Responses (%) all participants
What therapeutic indication is potassium permanganate solution used for?	Answer incorrect	83	17	13
	Unsure, don't know or made no comment	33	67	87
Why is potassium permanganate diluted before use?	Answer partly correct	8	92	27
	Answer incorrect	78	22	19
	Unsure, don't know or made no comment	42	58	54
What adverse reactions can potassium permanganate solution cause?	Answer partly correct	0	100	8
	Answer incorrect	20	80	10
	Unsure, don't know or made no comment	46	54	81
What is chloroform water used for?	Answer partly correct	0	100	6
	Answer incorrect	0	100	2
	Unsure, don't know or made no comment	43	57	92
What percentage strength is single strength chloroform water?	Answer incorrect	33	67	12.5
	Unsure, don't know or made no comment	40	60	87.5
What is the standard % v/v strength for: concentrated chloroform water, concentrated peppermint water, concentrated witch hazel	Answer incorrect	40	60	10
	Unsure, don't know or made no comment	40	60	80
	Answer partly correct	38	62	17
Betamethasone ointment standard strength is 0.1%w/v. Why might you wish to dilute this with white soft paraffin?	Answer incorrect	44	56	19
	Unsure, don't know or made no comment	39	61	65
	Answer partly correct	86	14	29
Two antibiotic bottles both contain 1g of dry powder for reconstitution to 100 ml. To reconstitute these to 100 ml, you add 75 ml of water to one bottle and 85 ml to the other bottle. Assuming both of these are correct, can you explain why these two volumes differ?	Answer incorrect	57	43	15
	Unsure, don't know or made no comment	33	67	56

**Table 7: Thematic analysis on second year students' responses**

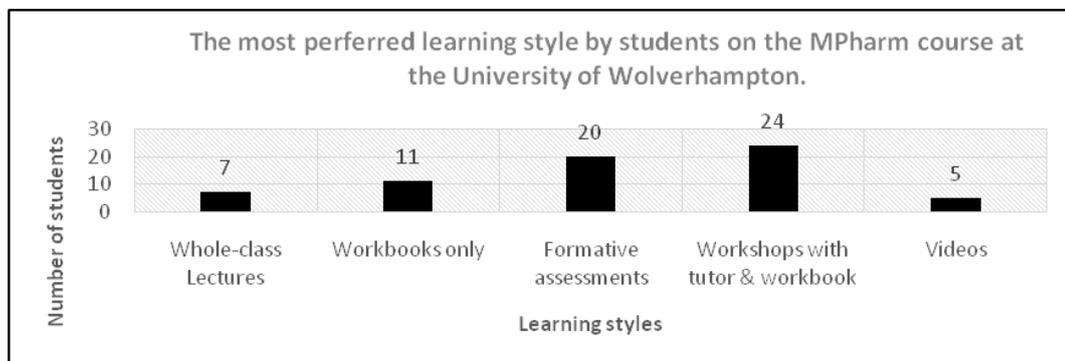
Learning styles	Whole-class lectures	Workbooks only	Formative assessments	Workshops with tutor and workbook	Videos
Responses for most preferred	Visual learner (7) Detailed explanations (2)	Independent learning (7)	Practice questions (3) Similar to the real exam (4) Recognise areas of weakness (7) Pressure (9)	Apply knowledge (6) Ask for help (18)	Can re-watch again (4) Visual/audio learner (2)
Responses for least preferred	No interaction (5) Independent learner (3) learn at a different pace (3) Lack of concentration (4)	Can't ask questions (10) Hard to cover new concept alone (3)		Independent learner (3) Lack of concentration (4)	Lack of detail (4) can't ask questions (10) A single method shown (2)
Participants who did not attempt the question	19				

\*brackets indicate the number of students whose responses fit into the theme

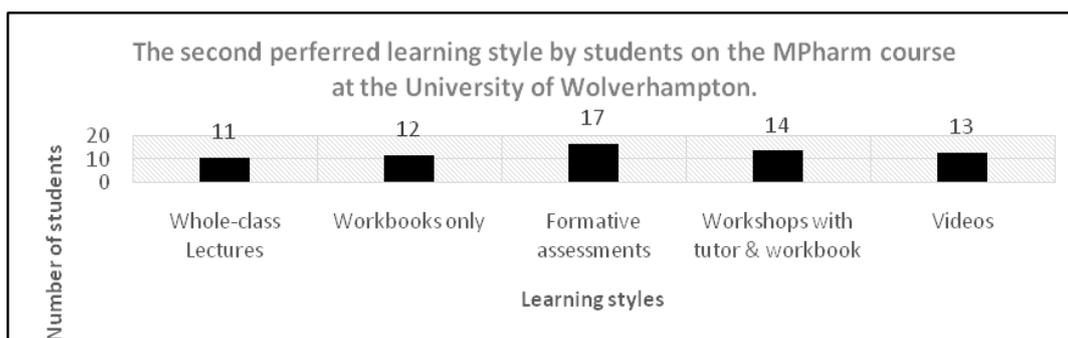
**Table 8: Thematic analysis on third year students' responses**

Learning styles	Whole-class Lectures	Workbooks only	Formative assessments	Workshops with tutor and workbook	Videos
Responses for most preferred	Visual learner (4) Interaction, can ask questions (4)	Independent learning (6) Good revision tool (4)	Practice exam style questions (5) Identify areas of weakness (3)	Apply knowledge (10) Verbal explanations (8) Number of methods shown and interaction (11)	visual learner (3) practice questions (3)
Responses for least preferred	difficult to keep up (8) no interaction (6) Loss of attention (4)	Can't ask questions (12) Hard for new concepts (4)	Not good as a learning style (2)	Independent learner (2) Loss of concentration (2)	No interaction (17) No as straight forward when applying knowledge (4)
Participants who did not attempt the question	8				

\*brackets indicate the number of students whose responses fit into the theme, Question 20 represented in fig. 1-5 ranked the learning styles in graphical charts. The responses from both second and third years were merged and ranked. Workshop was selected as first option, followed by formative assessments and workbooks and lectures and videos came last.



**Fig. 1: The number of students who ranked the available learning styles as their most preferred**



**Fig. 2: The number of students who ranked the available learning styles as their second preferred**

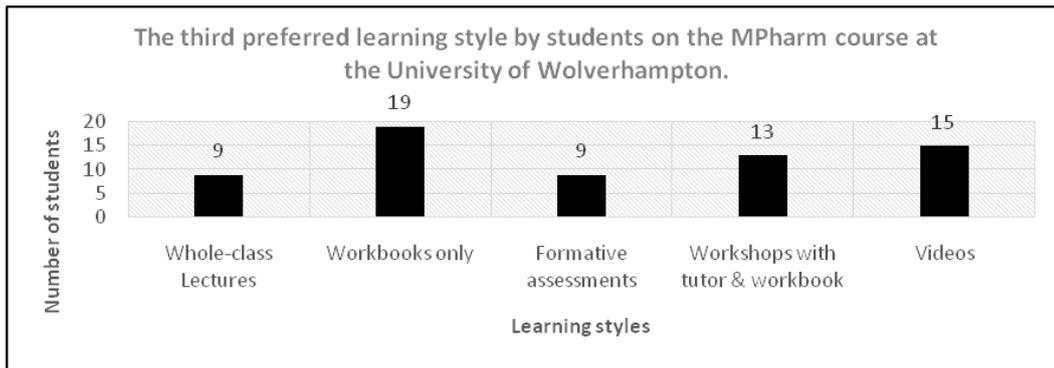


Fig. 3: The number of students who ranked the available learning styles as their third preferred

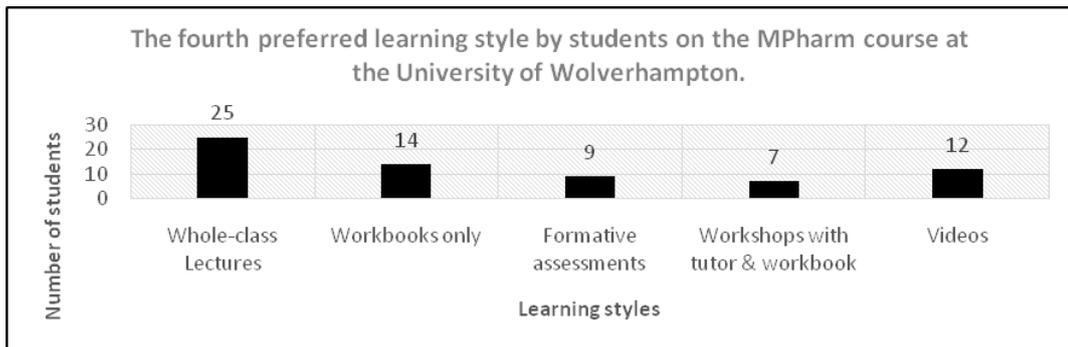


Fig. 4: The number of students who ranked the available learning styles as their fourth preferred

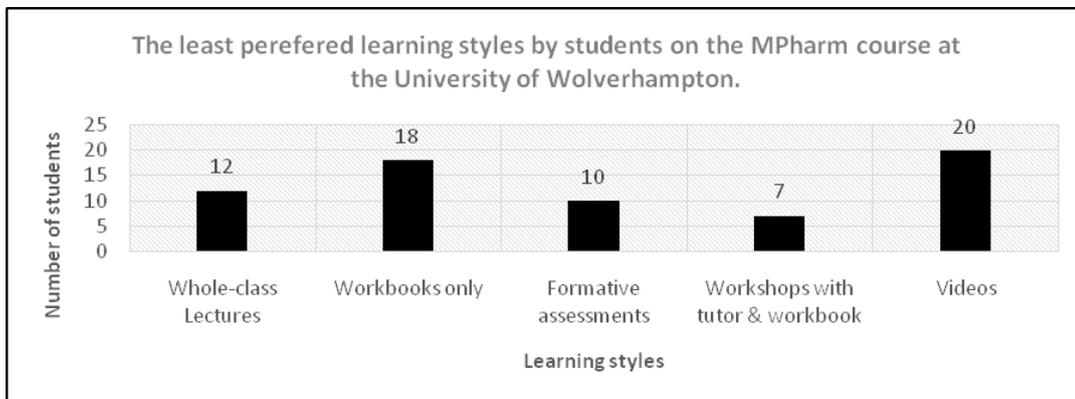


Fig. 5: The number of students who ranked the available learning styles as their least preferred

Table 6: Thematic analysis on the overall responses for question 21-22

Learning styles	Whole-class lectures	Workbooks only	Formative assessments	Workshops with tutor and workbook	Videos
Positive	Visual learner (11) Detailed explanations (2) Interaction, can ask questions (4)	Independent learning (13) Good revision tool (4)	Practice questions (8) Similar to the real exam (4) Recognise areas of weakness (10)	Apply knowledge (16) Ask for help (18) Verbal explanations (8) Number of methods shown and interaction (11)	Can re-watch again (4) Visual/audio learner (5) practice questions (3)
Negative	No interaction (11) Independent learner (3) Lack of concentration (8) difficult to keep up (11)	Can't ask questions (22) Hard to cover new concept alone (7)	Pressure (9) Not good as a learning style (2)	Independent learner (5) Loss of concentration (6)	Lack of detail (4) Can't ask questions (10) A single method shown (2) No interaction (17) No knowledge application (4)
No attempts	27				

\*Brackets indicate the number of students whose responses fit into the theme

Finally question 21-22, presented in table 7 were analysed using the thematic analytic technique. Only 121 students answered the questions. During the analysis, a range of similar themes were found and all answers to questions were read thoroughly to identify repetition. The responses were initially assessed in terms of for and against each type of learning style; they were then counted and recorded in terms of occurrence of themes.

## DISCUSSION

The results from this study are broadly similar to other published studies. An advantage of this study is that because our students are exposed to a variety of styles of delivery, they are able to make informed judgements about which methods they prefer, and what they believe enhances their academic performance and clearly these are not necessarily the same thing.

From our study, 67 participants; (36%) stated they most preferred workshops with a tutor and a workbook as their learning style. From 121 students, 53 provided positive responses as to why they believed these workshops were more beneficial than the other listed options. The themes that emerged highlighted how "verbal explanations" was perceived to facilitate better understanding of the content and improved performance. Of the students who ranked workshops as their most preferred learning style, 96% of students achieved grades of 70% or over in their final PCs exam. Similarly, Ofsted and Brunner<sup>9</sup> expressed how the "interaction" of staff and individuals at workshops was able to increase marks by around 20%. They suggested this may be due to having the opportunity to "ask for help" at the first instances or being able to "apply knowledge" they have gained from the demonstrations immediately and receive feedback. Within active workshops, tutors are perceived to demonstrate more than one learning method when compared to didactic lectures. Batchelor<sup>5</sup> stated this as a reason why more than 50% of students learn when a variety of methods were used and students were able to select a preferred method for future use, having a positive impact on improving retention and performance [10, 11]. Conversely 11 students did not consider workshops to be most beneficial; they perceived the long duration caused concentration fatigue and loss of focus with 5 students preferring to work independently rather than in a workshop.

Overall, 25% of participants favoured formative assessments as their second preferred learning style. Twenty two students left positive responses highlighting the impact of this learning style on performance. As seen by exam results, 94% of students (who ranked formative assessments in second place) received 70% or over and only 6% received between 39-69%.

A common theme identified how this particular learning style "recognises areas of weakness" due to individualised feedback. Gums [22] claimed this leads to higher test scores. More than half of the students who left a positive comment, stated formative assessments were "similar to real exams" and how these questions were best used for "practice" purposes. Both Nutan [23] and Lacroix [24] and Enz and Frosch [21] agreed; students who participate in regular formative assessments, stress less so this learning style relieves students' anxiety without affecting their retention or performance [3, 20]. However 9 students reported feeling "pressurised" by regular assessments and 2 students suggested formative assessments are "not good as a learning style" since no actual learning takes place, suggesting they are better as an indicator of what an individual knows or understands.

All participants ranked workbooks in third position. Seventeen students made positive comments compared to 29 who identified disadvantages of using workbooks on their own. All the students who commented on workbooks achieved grades of 70% and over. Less than half of these identified as being "independent learners" and thus preferred all the content within workbooks. Also Branch and Rodgers [14] expressed how students prefer this type of style due to them being able to work at their own pace and within their own comfort and time, thus getting a better grasp at the sub-topics. 4 students particularly liked using the workbooks as a "revision tool". On the other hand, more disadvantages were stated by students, in fact 22 students disapproved of the learning style due to being "unable to ask questions" and the lack of interaction amongst

students and tutors. In agreement, Van [15] claimed being unable to address issues face to face can affect performance. Also students felt these booklets covering sub-topics were "hard to cover as a new concept alone" and therefore required a tutor to display and explain methods step by step which they can later apply to questions in the future.

There was 37% displays whole-class lecturers as the fourth ranked learning style amongst the selection. 17 positive comments were compared against 33 negative comments about this particular learning style. 96% of these students achieved grades of 70% or over, while 4% received grades of less than 39% in their final PCs examination. The most common theme derived by students was being "visual learners" and favouring the addition of "interaction" with tutors. The findings suggest like Fike [17], students felt the "interaction" allowed them to "ask questions" at any stage of the "detailed" demonstration and explanations, thus further enhancing students understanding, retention and academic performance. However 11 student stated how they were "unable to keep up" with whole-class lectures due to the fast pace. Also the full on lectures with large groups of individuals led students to "lacking in concentration" and "interaction", in which Preszler and Hoopes [10] believes smaller classes will increase interactive engagement, cooperation and are more preferable by students. A minority of students claimed to be "independent learners" and therefore prefer to work on their own, which is supported by Fike [17] who expresses how no significant differences have been portrayed in grades from students who attend lectures to those who wish not to.

Amongst 67 participants, 30% least preferred videos compared to the other options. 12 students left positive comments while 37 individuals mentioned negative aspects about the learning style. 95% of students who generally commented on videos achieved grades of 70% and over, while 5% achieved grades between 39-69%. Most students stated themselves as being "visual or audio learners" whereas others generally felt using videos had a benefit of being "re-watched" again to either relook at difficult concepts right from a beginner's stage or replaying videos for revision purposes. This finding is further supported by Powers [18] and Karyn [16], who express how revisiting concepts multiples of times aid understanding and enhances learning and performance. Also students favoured the "practice questions" built within the videos as it gave them the opportunity to attempt methods, in agreement with Karyn [16] this aspect is known to improve exam grades. On the other hand students claimed the videos were "not interactive" and "not as straight forward when applying knowledge" thus disadvantaging its benefits with a "single method" being demonstrated which "lacked in detail". Van [15] also supported a theme derived on how videos eliminate the chances of "asking questions" which is one of the reasons why students prefer face to face learning styles compared to those over a screen.

Finally although no assumptions should be made when analysing the results, the fact that 100 out of 148 (68%) students chose not to answer questions 12-19 implies that they were either unable to answer them or were not comfortable to do so. A range of 54-92% of participants took the opportunity to state either that they were "unsure" or "didn't know" the answers to the questions (table 5). Regardless of the year group, no single student was able to completely state the correct answers. The results reflect that the UoW need to consider addressing the issue of students being unaware or lacking understanding of the terms used within PC questions. They would also need to consider using a learning style which is most favoured by students and believed to be more beneficial in terms of enhancing performance.

One of the main limitations, was during the analysis of responses, a flaw was noticed in question 20, which asked students to rank the currently used learning styles for PCs in terms of preference and benefit. Less than half of participants ranked learning styles compared to the majority which used the numbers 1-5 as a Likert scale. This could have possibly been due to the layout of the question, where each learning style had an option to circle a number of 1-5 or may have been due to students rushing the questionnaire and therefore not reading the directions in bold which asked them to

rank the learning styles. Another aspect which may have caused student to use the numbers as a Likert scale was the fact that the questionnaire was handed out just before an iRAT exam, and thus leading students to rush the questionnaire to start their iRAT which is known to count partly for a core module grade. For future projects, the administration of the questionnaire would not be handed out before a timetabled exam and numbers from 1-5 would not be displayed in a table format for circling, instead students would be asked to physically rank the learning styles by writing numbers 1-5 by each option and only using each number once.

#### LIMITATIONS

Participants had different educational levels background e. g. B-level, A-level and GSEC, which could have possibly led to students preferring a learning style which they are familiar with. For future studies, inclusion and exclusion criteria would be applied to participants. Specifically for this study, students who regularly rely on additional sources (such as text books/private tutors) would need to be excluded as they would be achieving help outside the scope of the learning styles used to teach them a sub-topics, which would in fact effect their perception of the learning style. All participants would need to have an equal mathematics and PCs background with no additional support to obtain a fair representation on the learning styles that influence performance.

#### CONCLUSION

To conclude, it can be said that a significant number of second and third year students in the study sample ranked the currently used learning style in the following order: workshops, formative assessments, workbooks alone, whole-class lectures and videos, due to preferences which benefits their academic performance. The specific findings suggest that the views of students were similar to the authors from recent literature.

It was also identified that student slack an understanding of extemporaneous preparation terms and thus require more support to appreciate the need to learn compounding calculations. The university could potentially use a learning style, such as practicums, to teach this aspect of calculations.

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#### AUTHORS CONTRIBUTIONS

All the author have contributed equally

#### CONFLICTS OF INTERESTS

The authors declare no conflict of interest

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