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11. Learning clinical biochemistry diagnostic skills through reflection

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ABSTRACT

Future health professionals need to acquire analytic and diagnostic skills for prognosis and management of disease. However, future professionals need to be provided with the necessary competences to interpret and process the increasing generation of data produced by the exponential advances in biomedical knowledge and techniques. A novel pedagogic reflective strategy was implemented in 2016/17 in the final year module, “Clinical Biochemistry”, shared between the BSc Biomedical Science (BMS) and BMedSci Medical Science (BMedSci) programmes at De Montfort University (UK). The strategy aimed to encourage students to use reflection to resolve three clinical biochemistry case studies of increasing difficulty distributed throughout the year, as reflection has been shown to be effective in facilitating continuous learning and gaining practical skills. Students voluntarily resolved each case study and were provided with comprehensive feedback and marks for different criteria, including ability to reflect and comment. Marks gained for each of the criteria were compared statistically between them and between two academic years (2016/17 and 17/18) of implementation of the strategy. A significant increase in the performance of students as a result of participation in this project was seen. Despite the short duration of this intervention, the reflective pedagogy implemented was shown to facilitate the acquisition and development of critical thinking and reflection, relevant skills for any future healthcare professional. Finally, participants improved their communication and scientific writing skills.

KEYWORDS: reflection, critical thinking, clinical biochemistry, diagnostic skills.
1. INTRODUCTION

Future health professionals need to acquire analytical and diagnostic skills for the prognosis and management of disease. However, exponential advances in biomedical knowledge are making available new techniques and increasing the generation of data that require professionals equipped with the appropriate skills to appropriately interpret and process this new information (He et al., 2018). This is especially evident in biochemistry in which a myriad of new biomarkers can currently be monitored in a clinical tissue sample but, in turn, this requires that the health professional is undertaking continuous learning to understand their meaning and interpretation. Thus, different reports are demanding the necessity of teaching only the foundations of clinical or medical biochemistry and supporting students to become scientifically literate so they can become independent learners and interpret biochemistry data and literature information to apply it clinically (Afshar and Han, 2014).

Reflection is effective in facilitating continuous learning and gaining practical skills (Devi et al., 2017). Reflection and learning through experience, is an active and conscious process of mental exploration that periodically involves retrospective consideration of the meaning and connection between experience and learning (Gray, 2007), which involves questioning underlying conceptual frameworks so future decisions are informed (Sandars, 2009). Therefore, efforts should be put in place to promote and practice clinical reflection in healthcare and medicine programmes, which should be appropriately designed for effective implementation of reflection (Grant et al., 2007; Devi et al., 2017; Klemenz, 2018).

1.1. DMU pedagogic reflective strategy

Our innovative teaching group at De Montfort University (DMU, UK) implemented a novel pedagogic reflective strategy in the module “Clinical Biochemistry”, shared in two of our healthcare programmes [BSc Biomedical Science (BMS) and BMedSci Medical Science (BMedSci)] in 2016/17, to encourage these final year students to think critically and use reflection to resolve three different clinical biochemistry case studies of increasing difficulty distributed throughout that academic year. The introduction of this voluntary project to practise clinical case studies in medical biochemistry was as a result of student feedback in 2015/16, provided in final module level feedback, which requested academics enrolled in this module enhance its clinical and medical practic/applicability.

To create our reflective pedagogic strategy at DMU, we used the guided weekly reflection papers methodology developed by Quintanilla et al. (2012), after making adaptations and modifications based on the characteristics of our human health science students. Our novel reflective pedagogy has been described previously in Peña-Fernández et al. (2018a). Briefly, the DMU reflective pedagogy incorporates the methods described in Quintanilla et al (2012) with Problem-Based Learning (PBL) pedagogy (Jones et al., 2010), as PBL pedagogy can facilitate the acquisition of professional skills. Students voluntarily resolved three reflective case studies throughout the course; these questions consisted of a short medical history with a detailed biochemical profile and a few short answer
questions that students needed to answer in a two sides, maximum, of A4 to encourage precision and writing skills. Students that voluntarily responded to each case study received comprehensive feedback and marks for three main criteria, which they could then use to answer the subsequent reflective case study. The three main criteria consisted of: a) ability to extract all the fundamental concepts; b) ability to synthesise information and clarity of expression; and c) ability to reflect and comment. To resolve the different reflective case studies proposed, students needed to draw on their own knowledge and experience as well as perform a comprehensive literature review on the specific topic/question proposed, to help students acquire the necessary skills to become independent learners by interpreting literature information to apply it clinically (Afshar and Han, 2014). Finally, to avoid studying the topics as isolated entities students needed to search for correspondence of concepts with those taught in their programmes.

The preliminary results from this cohort of students we reexplained in detail previously (Peña-Fernández et al., 2018a), however very little conclusions could be drawn due to poor engagement with the reflective case studies project, as this was a voluntary project (specifically, only 23 out of 142 students enrolled in 2016/17 completed the first two case studies, with no participation from the BMedSci programme). Consequently, we repeated the project in 2017/18 with some modifications, to: a) determine the success of our novel reflective pedagogy strategy to enhance students’ reflection and critical thinking in large cohorts of healthcare students; b) identify the acquisition of transversal competences including problem-solving skills.

2. METHODS

Following the minimal amount of data available to extract conclusions gained during the first implementation of our novel reflective pedagogy strategy in large-scale healthcare programmes at DMU, we decided to launch it again in 2017/18, but with slight modifications to encourage participation. Moreover, we have performed a series of modifications to enhance our year 6 shared module of Clinical Biochemistry and promote reflection in all students and not only in participants in our reflective project. Thus, we have introduced mini-mock clinical biochemistry case studies throughout the course that were resolved in specific sessions and seminars; additionally, a specific clinical case study question was added in the final exam, with a similar structure as the reflective case studies but easier and more manageable within the time restraints of an unseen exam.

2.1. Context

Final year students enrolled in Clinical Biochemistry in 2017/18: BMS (n=194) and BMedSci (n=34), were offered participation in the reflective project via advertisement through the course virtual learning environment (Blackboard®) and announcements in module lectures. A description of the project was provided in the introductory lecture, in which outcomes of our previous project were displayed. Participation was entirely voluntary and offered without incentive and participants were
under no obligation to complete all cases studies offered.

2.2. Instruments

We used different quantitative approaches to determine the effectiveness of this reflective pedagogic strategy in facilitating the acquisition of reflective and some clinical biochemistry skills. The performance of the case studies was carefully recorded in an Excel spreadsheet designed for this study and marks obtained for each student for each of the main criteria were compared between them and with previous years using SPSS. Moreover, we used a validated feedback-questionnaire using the Likert scale (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree) in conjunction with open-questions (free-response), to collect comprehensive information about the project. Questionnaires can measure the degree of satisfaction of the teaching and learning processes (Peña-Fernández et al., 2015). Ethical approval was provided by the Research Ethics Committee at DMU (Ref. 1850) and written approval from participants was obtained prior to participation in the project. Students’ feedback would also be used to appropriately modify our novel strategy if required.

2.3. Process

We followed the same strategy and methods as in 2016/17 for the implementation of our pedagogic reflective strategy (Peña-Fernández et al., 2018a) in these healthcare programmes in 2017/18. However, the completion of the three case studies was restricted to the first term to encourage participation (as these final students are required to complete a demanding laboratory based final project in the second term). A detailed timetable was provided to students participating in this project, so academics involved had the necessary time to provide feedback and students time to understand the feedback and apply this to the subsequent case study.

3. RESULTS AND DISCUSSION

A total of 48 students (38 BMS and 10 B MedSci) voluntarily completed the first case study, although there was a notable reduction in the number of students that attempted the last case study provided, as described in Table 1. The reduction in the numbers of students throughout the performance of this project could be attributed to an increase in the number of practical sessions and work that they need to complete for their final year studies rather than a reduction in the students’ engagement, as discussed below in the analysis of the questionnaire.

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<th>1st case study</th>
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<tr>
<td>BMS students</td>
<td>38</td>
<td>25</td>
<td>13</td>
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<tr>
<td>BMedSci students</td>
<td>10</td>
<td>4</td>
<td>3</td>
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Table 1. Responses to each reflective question provided in 2017/18 by healthcare programme.
Marks gained for each of the criteria were compared statistically between them and between both academic years the project ran, to determine the effects of participation. Data analysed for both academic years indicated a significant increase in the marks received for ability to synthesise information and clarity of expression (p=0.01) and ability to reflect (p<0.02). An ANOVA of repeated measures for all the marks collected in the first two case studies launched in 2017/18 confirmed our previous results showing a significant increase in the performance of students as a result of participation in this project. These results could be attributed to the comprehensive feedback provided for each reflective case study, which each participant could use to resolve/attempt the following case study, as well as to natural progression in the module and formative exercises provided in seminars and lectures to promote clinical biochemistry reasoning and interpretation and promoting reflection and critical thinking.

Seventeen participants from this second cohort completed the specific feedback-questionnaire provided electronically by the end of the project by Surveyshare®, indicating high levels of enjoyment and satisfaction (58.8% agreed, 42% strongly agreed; Table 2) by participating in this voluntary experience.

| Table 2. Responses (%) to the feedback-questionnaire to evaluate the reflective project. |
|-------------------------------------------------|-------|------------|--------|----------------|
| The reflective exercises have improved my learning performance. | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|                                                                 | 0.0   | 0.0        | 5.8   | 41.2           | 52.9  |
| Completing the reflective exercises has had a positive impact on my professional development. | 0.0   | 5.8        | 0.0   | 52.9           | 35.3  |
| The design of the virtual microscope was suitable | 0.0   | 0.0        | 0.0   | 50.0           | 50.0  |
| My participation in the reflective project has helped with my exam preparation. | 0.0   | 5.8        | 11.8  | 35.3           | 47.1  |
| Participation in the reflective project has improved my critical thinking. | 0.0   | 5.9        | 5.9   | 58.8           | 29.4  |
| I consider that I have learned to reflect/improve my reflective skills. | 0.0   | 6.2        | 12.5  | 37.5           | 43.7  |
| The time available to complete and submit the work was adequate. | 0.0   | 11.8       | 5.9   | 47.1           | 35.3  |
| The number of the exercises proposed (3 reflective questions) was appropriate. | 0.0   | 0.0        | 5.9   | 58.8           | 35.3  |
| I am satisfied at having participated in this project. | 0.0   | 0.0        | 0.0   | 58.8           | 41.2  |

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Additionally, 88.2% (58.8% agreed; 29.4% strongly agreed; Table 2) considered that their critical thinking had improved and 81.2% (37.5% agreed; 43.7% strongly agreed; Table 2) had learnt to reflect and resolve general and frequent pathologies using clinical biochemistry information, which is in agreement with different studies that have indicated that that reflective learning may improve clinical reasoning and critical thinking (Devi et al., 2017). Moreover, students documented different benefits from their participation other than learning, e.g. 88% considered that the reflective project had helped them to prepare for their exams and a similar percentage indicated a positive impact on their professional development; and participants believed that participation in this project will help their careers.

In relation to the participation in the project, 81.25% of students that completed the questionnaire indicated that they would participate again, and no student choose the option “in hindsight would have preferred not to have participated”. 29.41% students indicated that overall participation on this project was difficult due to other commitments (such as work in the laboratory to complete their final projects or practicals/coursework in other modules). However, most participants indicated that the number of reflective case studies provided was sufficient (58.8% agreed; 35.3% strongly agreed; Table 2).

In the open answer questions, most students indicated that the incentive for participating in this voluntary project was exam preparation, obtaining feedback to enhance their scientific writing skills, and aid their learning and critical thinking. Participants requested very minor modifications to the current project, such as including more support in the lectures and changing some of the questions to multiple choice questions.

The results gained so far would suggest that the reflective learning project described here could be a useful mechanism for improving students analytical, problem solving and reflective skills and thus facilitate deeper learning of biochemistry and clinical knowledge. Significant improvement in scores in the different reflective questions might probe deeper learning, which would validate our novel reflective strategy as a useful learning tool. However, delivery of this project involved significant time for academics involved including the provision of comprehensive feedback in a very limited time. Academics believed that they would have struggled if participation in the project would have been higher. Therefore, despite the novel strategy having shown a successful impact for students, it might not be applicable for large cohorts of healthcare students without introduction of modifications, such as a reduction in the number of case studies delivered or a reduction in the amount of feedback provided.

Finally, the modifications carried out in the level 6 “Clinical Biochemistry” module to enhance its clinical applicability, were successful in enhancing students’ interest and engagement in the module in both programmes, mostly by encouraging students to resolve clinical biochemistry case studies. Thus, the reflective pedagogic intervention created could be an easy strategy to enhance the clinical practise in any healthcare module after performing the necessary adaptations to introduce this.
pedagogy, as supported in a similar project performed from our group to promote acquisition of basic medical parasitology clinical skills (Peña-Fernández et al., 2018b).

4. CONCLUSIONS

In conclusion, despite its short duration, the reflective pedagogy implemented was shown to facilitate the acquisition and development of relevant critical thinking and reflection skills for any future healthcare professional. In addition, this pedagogic intervention improved communication and scientific writing in participants, which would have benefited the performance of these students in their studies.

5. REFERENCES


