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Title:

**Preparedness of Undergraduate Dental Students in the United Kingdom:  
A National Study**

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## **Abstract**

*Aims:* To evaluate the self-perceived preparedness of final year dental undergraduate students in the United Kingdom.

*Methods:* Dental undergraduate students in their final year were invited by e-mail through the Dental Schools Council (DSC) to provide their responses to an online preparedness assessment scale. The data analysis was carried out using the RUMM2030 software which is specifically designed for Rasch analysis, a measurement model based on item response theory.

*Results:* Students felt adequately prepared to carry out simple clinical procedures and communication skills. However, low scores were reported on ability to assess orthodontic treatment needs, treatment planning, crowns, endodontics, research skills, referral for suspected oral cancer and raising concerns regarding inappropriate behaviour of colleagues.

*Conclusions:* The scale used in this study explored the self-perceived preparedness on a range of cognitive, clinical and behavioural attributes. The data show that the students felt prepared for the majority of the attributes expected from dentists. However, a number of areas were identified where students may benefit from further training and consolidation.

## Introduction

Since its inception in the United Kingdom, undergraduate dental education continues to evolve significantly. The General Dental Council (GDC) as a regulator expects the learning outcomes of undergraduate dental education to “reflect the full range of knowledge, skills and attitudes that a student must demonstrate to the level appropriate for registration i.e. *professionalism, communication, clinical and management and leadership skills*”.<sup>1</sup> The aim is to develop a rounded professional who, in addition to being a competent clinician will have the range of professional skills required to begin working as part of a dental team and be well prepared for independent practice. Although the GDC has defined the learning outcomes for undergraduate courses in dentistry, there is flexibility for individual dental schools to plan and deliver undergraduate dental curricula in whatever way they deem appropriate. The GDC monitors the quality of education through regular school inspections to ensure that universities provide education and clinical training in an appropriate and transparent manner. Dental schools in the UK have developed internal processes for assuring the quality of standards. These most commonly involve external examiners, processes for validation, student surveys and feedback, and periodic reviews and transparent systems of governance.<sup>2</sup>

Undergraduate dental education is a unique pedagogical experience with distinctive challenges. Training in dentistry involves performing irreversible operative procedures on patients under supervision of experienced clinicians. Nevertheless, the students carry a moral responsibility for their clinical work. A dental programme should not only equip the students with the required knowledge and skills but should also contribute towards their psychological and social well-being, as well as the cultivation of ethical values, professionalism and team-working skills.<sup>3</sup>

Numerous studies have been carried out to investigate the skills and attributes of undergraduate dental students in the UK. However, most of these studies focus solely on clinical skills.<sup>4-7</sup> Although clinical skills are extremely important, they only represent one of several dimensions of preparedness and most studies do not capture the broader skill set expected from a new dental graduate.

The aim of this study was to report our findings on the self-perceived preparedness of final year dental undergraduate students in the United Kingdom using a newly validated scale, namely, the Dental Undergraduates Preparedness Assessment Scale (DU-PAS). DU-PAS is a measurement tool that has been demonstrated to evaluate the broad range of skills and attributes expected from dental students at the time of graduation. Development and psychometric evaluation of the DU-PAS have been reported elsewhere.<sup>8</sup> The scale met with the rigorous psychometric demands of the Rasch model.<sup>9, 10</sup>

## Methods

Following approval by the institutional research ethics committee, dental undergraduate students in their final year from all UK Dental Schools were invited by e-mail through the Dental Schools Council (DSC). The participants were invited to provide their responses to an online preparedness assessment scale. The invitations were sent directly by the policy officer of the Dental Schools Council. A reminder was sent after two weeks and the URL for the study was deactivated 4 weeks after from initial invitation.

The data analysis was carried out using the *RUMM2030* (Perth, Western Australia: RUMM Laboratory Pty Ltd, 2010), software specifically designed for Rasch analysis, a measurement model based on item response theory.<sup>11</sup> Rasch analysis is an iterative process that identifies and studies anomalies in the data and the extent to which DU-PAS data conforms to the Rasch model. Fit to the Rasch model was established using a variety of statistics to demonstrate validity, reliability, unidimensionality. Analysis also confirmed that interval level scaling had been achieved and summation of scores from DU-PAS is legitimate.

## Results

In total 238 participants responded to the online survey. However, complete responses were only provided by 196 students (82%). The latter included 115 females (59%) and 81 males (41%). The majority of the participants were less than 30 years old (86%).

The summary statistics showed that the overall Rasch chi-square fit statistics for the preparedness scale was not significant ( $\chi^2=283.03$ ; d.f.=250;  $p= 0.073$ ), indicating an adequate fit to the Rasch model and good internal construct validity. Person separation index (PSI) identified the precision of the estimate of each person's level of ability was captured by DU-PAS. PSI is analogous with internal consistency (Cronbach's alpha) of a scale in classical test theory (CTT). The PSI value for the scale data analysis was high (0.897), indicating that DU-PAS was able to discriminate between three or more groups of final year undergraduates perceived level of ability with accuracy. *Differential item functioning* (DIF) of the scale was also assessed and did not identify any bias for person factors including gender and age.

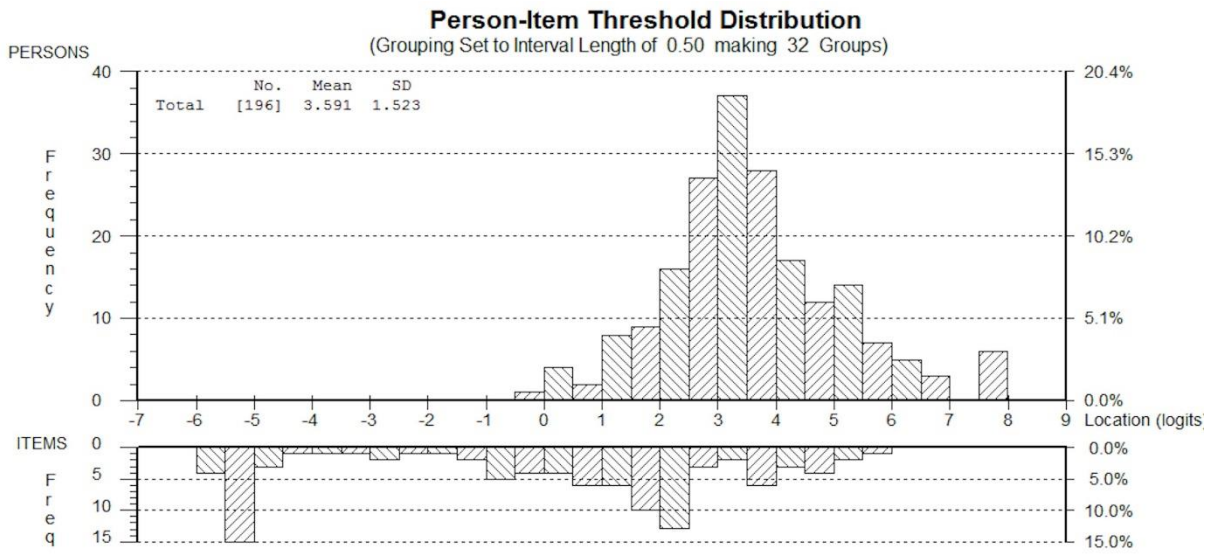
Undergraduate final year dental students' ability (person location) and item difficulty (level of ability captured by an item) are measured independently and expressed in log odd units (logits) which reflect logarithmic transformation of the raw scores. Positive values (higher logits) imply greater levels of ability while negative values (lower logits) indicate lower levels of ability. Logits can be transformed into interval level data. The scoring response categories and structure of the 50-item inventory with a maximum raw score of 100 is shown in the Appendix.

The person-item threshold distribution is depicted in Figure1 and shows the locations of the final year undergraduates (top half) and level of ability captured by the DU-PAS item thresholds (bottom half). The person location fit statistics showed that the mean

level of ability was scored at 3.591 logits; SD 1.523, which was higher than the mean item difficulty of 0.00. A mean score of 3.591 logits translates into a raw score of 74 out of 100. The mean ability of males (n=81) was 3.652; SD=1.44 was slightly higher than the mean ability of females (n=115) which was estimated to be 3.548; SD=1.58. However, ANOVA statistics showed the effect of gender on person ability was not significant [ $F(1, 195) = 0.222, p=0.634$ ].

As would be expected with undergraduates at the point of graduation distribution of students were skewed towards the higher end of DU-PAS. Output from analysis from RUMM2030 software identified the hierarchical location of the items in terms of the likelihood that students would affirm them. These item locations can be seen in Table 1 and reflect the skills expected from undergraduates at the point of graduation. For example, *taking a medical history* (location -3.48) is an easy item that all students at the point of graduation should have mastered whereas at the other end of the ability spectrum is *evaluate new dental materials* (location +3.55) as shown in Figure 1 less than 10% of students affirmed this item.

The difficulty levels of the 50 items on the scale are shown in Table 1 which lists the items in location (difficulty) order. Negative values (lower logits) indicate lower levels of difficulty (easy items) while positive values (higher logits) imply an item with higher difficulty.



**Figure 1 Person- item threshold distribution**



**Table 1 Item Difficulty in Location Order**

| <b>Item</b>  | <b>Location</b> | <b>SE</b> | <b>ChiSqu</b> |
|--|-----------------|-----------|---------------|
| Obtain medical history                                   | -3.48           | 0.721     | 1.248         |
| Obtain a valid consent for treatment                     | -2.534          | 0.441     | 2.158         |
| Undertake clinical oral examination                      | -2.346          | 0.265     | 2.41          |
| Restore teeth with tooth coloured fillings               | -2.282          | 0.258     | 3.264         |
| Administer inferior alveolar nerve blocks                | -2.252          | 0.248     | 6.802         |
| Undertake bitewing radiographs                           | -1.995          | 0.417     | 0.511         |
| Undertake periapical radiographs                         | -1.867          | 0.337     | 4.149         |
| Restore teeth with amalgam fillings                      | -1.863          | 0.216     | 4.39          |
| Explain merits & demerits of treatment                   | -1.818          | 0.197     | 10.324        |
| Maintain accurate dental records                         | -1.781          | 0.343     | 2.777         |
| Carry out treatment in an appropriate order              | -1.734          | 0.347     | 6.55          |
| Communicate appropriately with colleagues                | -1.695          | 0.346     | 1.491         |
| Maintain patient confidentiality                         | -1.609          | 0.448     | 3.925         |
| Communicate effectively with patients                    | -1.597          | 0.194     | 5.413         |
| Explain treatment options to patients                    | -1.565          | 0.305     | 10.657        |
| Encourage patient to express expectations                | -1.480          | 0.331     | 6.38          |
| Prescribe dental radiographs                             | -1.458          | 0.299     | 2.378         |
| Work as effective team member                            | -1.413          | 0.179     | 5.835         |
| Communicate treatment risks to patients                  | -1.410          | 0.319     | 2.526         |
| Recognise personal limitations                           | -1.409          | 0.189     | 14.33         |
| Interpret dental radiographs                             | -1.407          | 0.178     | 2.455         |
| Restrict relations with patients to a professional level | -1.340          | 0.466     | 5.171         |
| Comprehensive treatment planning                         | -1.065          | 0.169     | 6.677         |
| Motivate patients to encourage self-care                 | -0.915          | 0.281     | 1.005         |
| Self reflection  | -0.849          | 0.319     | 10.787        |
| Non-surgical periodontics                                | -0.385          | 0.293     | 2.27          |
| Remove dental caries effectively                         | -0.180          | 0.192     | 3.161         |
| Undertake non-surgical extractions                       | 0.705           | 0.167     | 9.002         |
| Recognise legal responsibilities                         | 0.718           | 0.302     | 4.962         |
| Manage patient's expectations                            | 0.799           | 0.182     | 10.058        |
| Address barriers to communication                        | 0.809           | 0.286     | 6.339         |
| Ask for help   | 0.826           | 0.293     | 2.267         |
| Manage behaviour of children                             | 1.372           | 0.215     | 15.108        |
| Scientific knowledge                                     | 1.468           | 0.294     | 9.415         |
| Prescribe drugs  | 1.606           | 0.278     | 2.799         |
| Refer complex treatments                                 | 1.651           | 0.253     | 5.98          |
| Work within time constraints of clinical appointments    | 1.659           | 0.175     | 3.07          |
| Provide mechanically sound partial dentures              | 1.700           | 0.155     | 4.308         |
| Manage anxious patients                                  | 1.714           | 0.257     | 7.259         |
| Provide mechanically sound full dentures                 | 1.838           | 0.158     | 7.324         |
| Take responsibility for CPD                              | 1.905           | 0.134     | 6.555         |

|  |       |       |        |
|--|-------|-------|--------|
| Perform endodontics on single rooted teeth | 2.018 | 0.136 | 6.521  |
| Use an evidence-informed approach          | 2.057 | 0.149 | 5.954  |
| Provide crowns                             | 2.381 | 0.144 | 7.584  |
| Perform endodontics on multi rooted teeth  | 2.861 | 0.144 | 5.269  |
| Assess orthodontic treatment needs         | 2.89  | 0.171 | 12.447 |
| Refer oral cancer                          | 2.949 | 0.116 | 7.779  |
| Interpret results of research              | 3.215 | 0.266 | 4.279  |
| Raise concerns                             | 3.233 | 0.207 | 5.902  |
| Evaluate new dental materials              | 3.355 | 0.131 | 3.814  |

## **Discussion**

This is the first study to investigate the cognitive attributes, clinical and affective skills of undergraduate students using the Dental Undergraduates Preparedness Assessment Scale (DU PAS). The scale was developed using a mixed methods approach.<sup>8</sup> Qualitative methods including semi-structured interviews were used to identify the essential attributes of preparedness of dental undergraduates for a smooth transition into foundation training.<sup>12, 13</sup> Psychometric evaluation of the scale was undertaken using the Rasch analysis, an item response theory probabilistic model. . Many readers may not be familiar with the Rasch model and its application in scale development. It is suggested that interested readers may refer to the relevant literature.<sup>8</sup> This study underscores the need to evaluate preparedness of undergraduate skills in the context of a range of clinical as well as behavioural attributes.

Analysis of the hierarchy of the items showed that some of the easiest items were affirmed by most of the undergraduates at the point of graduating as might be expected. It also identified that some of the more specialist aspects of dental practice are not necessarily areas that all students feel confident in. The ability to know students level of ability matched to the ability defined by individual items is one of the hallmarks of studies using Rasch analysis. Unlike CTT where it is theorised that any observed score on a measurement tool consists of a true score and error score and these cannot be determined. Rasch provides us with a clear measure of a person's ability and their location on that scale.<sup>10</sup>

Closer examination of the items as afforded by Rasch analysis demonstrated that the students were confident undertaking basic assessments of patients such as obtaining

a medical history, carrying out clinical oral examination, undertaking intra oral radiographs. However, they were less confident to prescribe and interpret findings on dental radiographs. The students were least prepared to assess orthodontic treatment needs of patients. Our findings are different to those reported from another study from a dental school in the UK recently where students reported high levels of self confidence in carrying out orthodontic assessments.<sup>14</sup> These differences may be attributed to differences in the teaching, training and assessments of undergraduate students in UK dental schools.<sup>15</sup> Perhaps a separate multi-site study focusing on orthodontic skills in undergraduate students may provide clarifications on this subject.

The students were less confident in comprehensive treatment planning to address all treatment needs of their patients and similar findings are reported in studies on foundation dentists.<sup>16, 17</sup> Deficiencies in treatment planning skills are reported in studies on dental students in USA.<sup>18</sup> Nevertheless, the students felt prepared in regards to several elements of treatment planning including: explaining the merits and demerits of treatment options; encouraging patients to express their expectations of treatment; obtaining a valid consent; maintaining patient confidentiality; and carrying out treatments in an appropriate order.

Low scores were reported on the ability to refer suspected oral cancer. There is a dearth of published data on oral cancer referral skills of undergraduate dental students in the UK. However, studies from other parts of the world also show a perceived lack of knowledge and skills among dental students to recognise oral cancer which may potentially result in sub-optimal prevention and referral for oral cancer management.<sup>19,</sup>

<sup>20</sup> The findings of the present study underscore the need to re-evaluate and strengthen the teaching and training of dental students in regards to oral cancer recognition and referral.

With regards to operative clinical skills, the students felt well-prepared to administer inferior alveolar nerve blocks, restore teeth with tooth-coloured filling materials and amalgam and providing non-surgical periodontal treatments. Preparedness was also perceived to be adequate for caries removal, non-surgical extractions, and provision of partial and complete dentures.

However, the students felt least prepared to undertake endodontics and provide crowns. Deficiencies in endodontic skills of undergraduate students in the UK have been highlighted in a number of studies.<sup>14, 17</sup> Understandably, the students were less confident in undertaking endodontic treatments on multi-rooted teeth compared to single root teeth. In a previous study, evaluation of the technical quality of endodontic treatments provided by dental students showed that the quality was judged to be acceptable in 49% of all the single-rooted teeth and only 17% of all the multi-rooted teeth treated by undergraduate dental students.<sup>6</sup>

Perceived deficiencies in clinical skills of students are widely reported. However, it needs to be reiterated that clinical competence of students only represents a point on a continuum and needs several years of consolidation in clinical practice settings.<sup>21, 22</sup> Furthermore, competence in clinical practice is dependent on a habit of lifelong learning.<sup>21</sup> Notwithstanding the need to ensure that students get further training and experience in clinical settings, there may also be a case of moderating expectations from students in regards to the level of competence which can be achieved realistically during an undergraduate programme.

The students appear to be largely confident in their communication skills with colleagues and patients. However, addressing barriers to communication with patients was considered to be more challenging than routine communication. Moreover, the

students felt least confident in raising concerns about inappropriate behaviour of colleagues. Communication skills along with professionalism are recognised as key attributes for new dental graduates.<sup>1, 24</sup> Lack of confidence in addressing barriers to communication and raising concerns may be attributed to limited experience in clinical settings. Perhaps there is merit in considering enhancing student experience using simulated scenarios.

Overall, the students felt least prepared with regards to using evidence-informed research in their clinical practice; evaluating new dental materials; and interpreting the results of research. Although the aforementioned attributes are included in the learning outcomes for dentists by the GDC<sup>1</sup> there is limited published literature aimed at evaluation of these skills amongst the undergraduate students. Nevertheless, our findings corroborate those of other studies which highlight that the undergraduate dental students lack confidence regarding their knowledge and skills in evidence-based dentistry.<sup>25, 26</sup> Dental students need to develop skills to search and analyse high-quality evidence to practice effectively in an age of rapid technological advancements and information overload.

The study has some limitations. Firstly, the endorsement of the items on this scale was based on self-assessment by the students and it is possible the mean person ability (perceived preparedness) may be inflated. Evidence from studies on health professions training has consistently shown poor correlations between perceived self-confidence and observed competence.<sup>27-29</sup> The next step may be to compare the scores of self-assessment with the assessment by dental educators and clinical supervisors, which may identify differences in scores and provide a more realistic measurement of person ability. Any differences in self-assessment and assessment

by the educational supervisors can help to gauge the insight of students.<sup>30</sup> This information may be used to provide feedback to the students accordingly. Secondly, this study had a low response rate. The invitation to participate in this study was sent close to the BDS finals examinations which may have contributed to the low response rate. Although the study involved considerable planning and the sample size was adequate for psychometric analyses, the findings of this study need to be interpreted with a degree of caution. It is recommended that future national studies on undergraduate students should involve a designated representative from each dental school to help disseminate the information about prospective studies more widely with the aim to achieve higher response rates.

## **Conclusions**

This study explores the preparedness of undergraduate dental students in the UK. The scale used in this study explored the self-reported preparedness on a range of cognitive, clinical and behavioural attributes. The data show that the students felt prepared for majority of the attributes expected from dentists. However, a number of areas were identified where students may benefit from further training and consolidation. The findings of this study may be of interest to dental educators and other stakeholders in the UK and beyond.



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## Appendix: Dental Undergraduates Preparedness Assessment Scale

|        |  |
|--------|--|
| Part A |  |
|        | I am able to obtain a complete medical history from my patients.   |
|        | I am able to undertake a comprehensive, clinical oral examination  |
|        | I am able to prescribe appropriate dental radiographs  |
|        | I am able to undertake periapical radiographs  |
|        | I am able to undertake bitewing radiographs  |
|        | I am able to interpret common findings on dental radiographs   |
|        | I am able to assess the treatment needs of patients requiring orthodontics                               |
|        | I am able to formulate a comprehensive treatment plan which addresses all treatment needs of my patients |
|        | I am able to provide a range of treatment options to my patients based on their individual circumstances |
|        | I am able to explain the merits and demerits of various treatment options to my patients                 |
|        | I am able to obtain a valid consent from my patients prior to undertaking any treatment.                 |
|        | I am able to carry out patients' treatment sessions in an appropriate order                              |
|        | I am able to prescribe drugs to my patients appropriately  |
|        | I am able to administer inferior dental nerve blocks effectively   |
|        | I am able to perform non-surgical periodontal treatment using appropriate methods                        |
|        | I am able to remove dental caries effectively  |
|        | I am able to restore teeth with tooth coloured fillings appropriately                                    |
|        | I am able to restore teeth with amalgam fillings appropriately   |
|        | I am able to perform endodontic treatment on single rooted teeth appropriately                           |
|        | I am able to perform endodontic treatment on multi rooted teeth appropriately                            |
|        | I am able to provide crowns using principles of tooth preservation                                       |
|        | I am able to provide mechanically sound partial dentures   |
|        | I am able to provide mechanically sound full dentures  |
|        | I am able to undertake non-surgical tooth extractions appropriately                                      |
| Part B |  |
|        | I feel I can manage peoples' expectations of their treatment   |
|        | I feel able to motivate my patients to encourage self-care for their dental needs                        |

|        |   |
|--------|---|
|        | I recognise my personal limitations in clinical practice                                      |
|        | I feel comfortable asking for help from supervisor or colleague if needed                     |
|        | I am able to refer patients with complex treatment needs appropriately                        |
|        | I feel confident referring patients with suspected oral cancer                                |
|        | I reflect on my clinical practice in order to address my learning needs                       |
|        | I have sufficient knowledge of scientific principles which underpin my dental practice        |
|        | I am confident to evaluate new dental materials and products using an evidence-based approach |
|        | I am confident to interpret the results of research which may influence my practice           |
|        | I use an evidence-informed approach in my clinical practice.                                  |
|        | I feel I can manage to communicate effectively with my patients                               |
|        | I provide opportunities for my patients to express their expectations from dental treatment   |
|        | I feel confident to address barriers to effective communication with patients appropriately   |
|        | I feel confident to communicate potential risks of operative procedures to patients           |
|        | I feel confident to communicate appropriately with my colleagues                              |
|        | I feel confident managing anxious patients with appropriate behavioural techniques            |
|        | I am able to manage the behaviour of children to enable appropriate dental treatment          |
|        | I am able to fulfil my responsibilities as an effective member of the dental team             |
|        | I maintain accurate records of my clinical notes  |
|        | I am able to work within the constraints of clinical appointment schedules                    |
|        | I take responsibility for my continuing professional development                              |
|        | I am aware of my legal responsibilities as a dental professional                              |
|        | I restrict my relations with my patients to a professional level                              |
|        | I feel able to raise concerns about inappropriate behaviour of my colleagues                  |
|        | I take appropriate measures to protect patient confidentiality                                |
|        | <b>Response Categories</b> <b>Numerical Score</b>   |
| Part A | No Experience 0   |
|        | With verbal and / or practical input from a colleague 1                                       |
|        | On my own, independently 2  |
| Part B | No Experience 0   |
|        | Mostly 1  |
|        | Always 2  |

