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Evaluation of entrustable professional activities and competency assessment in sport and exercise sciences in higher education: Student perceptions of the impact on learning

Dr Eddie J. Bradley [a,*], Dr Lisa Board [a], Dr David Archer [a], Mikeala Morgans [b]

[a] Faculty of Health Sciences and Wellbeing, City Campus, University of Sunderland, Sunderland, SR1 3SD, United Kingdom
[b] Faculty of Education and Society, St Peter's Campus, University of Sunderland, Sunderland, SR1 3SD, United Kingdom

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ABSTRACT

The aim was to evaluate the implementation of entrustable professional activities (EPA) to identify student perception of value and purpose to their learning. A framework and matrix were developed and implemented into a Sport and Exercise Sciences module of an undergraduate degree. Evaluation was completed through questionnaires and focus group interviews to identify students' perceptions. Data were analysed and interpreted through content and thematic analysis. Statistical analyses were conducted to identify if significant differences existed in perceptions due to gender, awareness, and purpose, and a cluster analysis was used to identify commonalities in perceptions. Findings support a positive perception with students reporting the matrix was communicated well (80% agreement) and was easy to understand (93%), with clearly distinguished statements (97%) appropriately aligned to the profession. EPAs offer a well-structured, easy to use teaching and learning tool to aid student professional development with minimal barriers to its application in practice.

1. Introduction

Sport and Exercise Science is a discipline that involves the application of scientific principles to enhance performance or improve health through sport, exercise, and physical activity. Sport and Exercise Sciences graduates are expected to display scientific knowledge and understanding across three core sub-disciplines of biomechanics, physiology, and psychology, along with other sub-disciplines, for example nutrition and motor skill acquisition. As an applied profession, the development of practical and professional skills and authentic professional competency form an important component of student learning. The ability to perform with a high level of practical capability is advantageous and now commonly seen as a requirement of the role (Le Meur & Torres-Ronda, 2019), and is essential for professional recognition as an Accredited Sport and Exercise Scientist through the British Association of Sport and Exercise Sciences (BASES), the recognised professional body in the United Kingdom (UK). The BASES undergraduate endorsement scheme (BUES) sets threshold quality standards for undergraduate sport and exercise degree courses in the UK, awarding endorsement to courses that provide undergraduates with the opportunity to develop the breadth and depth of knowledge and practical skills essential to enter into the profession (British Association of Sport and Exercise Sciences, 2021). However, as a non-regulatory body, there is currently no defined or standardised procedure to ensure graduates leave University with the requisite

* Corresponding author.
E-mail address: eddie.bradley@sunderland.ac.uk (D.E.J. Bradley).

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practical or professional skills to confidently perform tasks associated with the broad role of a sport and exercise scientist (Ten Cate, 2018; Smith, 2019). Individual accreditation as a Sport and Exercise Scientist is a career path many graduates choose to take following a period of postgraduate study and applied practice. There remains therefore an opportunity to explore ways to develop and assure practical and professional competency at the undergraduate level of education.

Entrustable professional activities (EPA) provide an indicator of practical competency within a field of work and are generally derived from competency-based medical education (CBME) (Bradley et al., 2022). CBME enables a course to be structured where specific technical and professional skills required for a role are identified, and these outcomes are used to designate teaching delivery and assessments approaches (Ten Cate & Scheele, 2007). From this structure, clear programme and module learning outcomes can be aligned to professional body standards. EPAs are objective, observable and measurable tasks (McCloskey et al., 2017; Ten Cate, 2005) that are described through statements of actions that students are required to complete. Within professional structured learning, the aim of an EPA is to enshrine the standards required of a trained person, enabling them to complete the task with minimal supervision (McCloskey et al., 2017; Weller et al., 2014). In essence, an EPA is an activity that integrates work-related learning to develop an adequate level of competence (Meyer et al., 2019), which in turn increases confidence in both the learner and educator (Ten Cate & Taylor, 2021).

When implementing EPAs, particularly in educational programs where they are novel, it is beneficial to understand factors influencing student learning and development of their abilities. For example, using a qualitative multicentre approach across three European medical and veterinary institutes, and adopting a nominal group technique approach with a sample of 32 students, Duijn et al. (2017) clearly describe how student perceptions of feedback in the EPA educational process aid their progression to an end-point of entrustment and non-supervision. However, despite providing useful guidance on the EPA feedback process, Duijn et al. (2017) did not examine the students' thoughts, feelings and concerns relating to the EPA process or statements, or how these may enhance the educational learning process.

Where studies have specifically investigated student perceptions of EPAs for developing practical skills, the use of statements in the education and assessment process is usually reported positively (Rhodes et al., 2017). After questioning 423 Doctor of Pharmacy students, Pittenger et al. (2019) reported that all EPA statements were perceived as relevant and that progression existed in the EPA structure as the students perceived the requirement for supervision decreased across the four years of the programme. Similarly, Lau et al. (2020) reported positive perceptions towards EPAs within a sample of undergraduate nursing students, who considered EPAs useful for the facilitation of critical thinking, flexible assessments, and team-based teaching (Lau et al., 2020). Such outcomes highlight the usefulness of EPA in generating a student focused learning environment.

In an exploration of how EPAs can be utilised in Sport Science education, Smith (2019) stated that professional standards should be derived from national body frameworks and these standards should inform the creation of EPAs related to applied practice. Additionally, (Bradley et al., 2020) explained that EPAs are a well-structured teaching and learning tool with clear alignment to the discipline of Sport and Exercise Sciences. EPAs may aid the professional development of attributes and skills required to produce work-ready sport and exercise science graduates. Furthermore, EPAs should progressively increase in complexity, to nurture breadth and depth of expertise and autonomy in future graduate practitioners (Ten Cate, 2013). However, currently the use of EPAs within undergraduate training and professional development of sport and exercise practitioners is sparse, and their value within the teaching and learning of this discipline remains open to investigation. Therefore, the aim of the study was to explore learner perceptions towards entrustable professional activities implemented within an undergraduate sport and exercise sciences learning environment.

2. Methods

An explanatory-sequential, complementarity, mixed method approach (Creswell, 2003; Wisdom & Creswell, 2013) was adopted to evaluate the EPA framework and competency assessment processes, using a questionnaire followed by semi-structured focus-group interviews, to provide a diverse and enriched understanding of individual experiences. It was intended that this approach would allow connections and contradictions between data, and variations in perspectives between the participants to be established and illuminated. In addition, the use of a complementarity approach through quantitative questionnaire data and qualitative focus group methods sought elaboration, enhancement, illustration, or clarification of the results between methods (Greene et al., 1989).

The research was conducted in three stages. First, an EPA framework based on the BASES Accreditation competency profile (www.bases.org.uk) was developed and implemented within a new introductory (first-year; Level 4) module on a BSc Sport and Exercise Sciences course. This module ran in the first semester of the course and was focused on the development of practical skills across the core sport and exercise sciences sub-disciplines (biomechanics, physiology, and psychology). The module is a single semester 20-credit module that was taught through a 1-h lecture, a 2-h practical followed by a 1-h seminar to discuss or analyse the practical. One senior academic (module convenor) and two academic tutors taught across the module to an enrolled class size of 45 students split into three groups. Subsequently, a questionnaire was administrated to gather student perceptions of the EPA process and, in the final stage, semi-structured focus group interviews encouraged detailed discussions to elicit an in-depth understanding of student perceptions towards implementation of the EPA process.

Three EPA domains of Effective Implementation, Evaluation of Practice, and Student Behaviours were defined (Bradley et al., 2022) and included 12 actions (Goal Setting and Planning; Communication of Procedure; Selection of Equipment; Measurement and Data Handling; Maintain Health and Safety; Analysis and Interpretation; Validity and Reliability Assessment; Engagement With Client; Ability to Apply Research; Autonomy of Practice; Maintaining Inclusion and Diversity; Duty of Care) that the students were required to demonstrate. This ensured that all ten BASES Accreditation competencies were covered by the three EPA domains. Ethical approval was obtained from the institutional Research Ethics Committee (Ref No. 005850). Additionally, the focus groups were audio recorded

and the data were anonymised, General Data Protection Regulation 2016/679 (GDPR) compliant and stored according to the UK Data Protection Act (2018). All students on the module (n = 45, mean age 19.5 ± 2.8 years; males: n = 33, 73%, mean age 19.3 ± 2.0 years; females: n = 12, 27%, mean age 20.2 ± 4.6 years) were invited to complete the questionnaire, participate in the focus groups, or both. Participants were informed of their right to not participate or to withdraw. They were verbally assured their participation, or non-participation, would not impact on their assessment or module grades. Written informed consent was obtained to confirm participation was voluntary.

The questionnaire consisted of 15 items. Responses were scored using a 6-point Likert scale where 1 indicated strongly disagree and 6 indicated strongly agree with the statement. The questionnaire focused on the understanding, value, and purpose of the EPA framework and competency assessment to identify if the students benefited from its inclusion in the module. Students were invited to complete paper copies of the questionnaire in the final week of the semester long module. A follow-up reminder was emailed to all participants after seven days to optimise the response rate.

On completion of the module, all students were verbally invited by the module convenor to participate in focus groups. Participants were provided with an information sheet detailing the purpose of the focus group and were given the opportunity to ask questions. Once fully informed, written consent was obtained. Focus groups were organised to be completed in person at the end of class. However, due to the Covid-19 pandemic and subsequent national lockdown and University closure, the focus groups were conducted online via a video conference application in the module virtual learning environment (VLE; Canvas, BigBlueButton). This reduced the availability of students and three focus groups were eventually completed with four, one and two students in each (total n = 7, mean age 19.9 ± 2.8 years; males: n = 5, 71%, mean age 20.4 ± 3.2 years; females: n = 2, 29%; mean age 18.5 ± 0.7 years). All focus groups were audio recorded using a Dictaphone for subsequent analysis and validation and each focus group lasted no longer than 40 min. A semi-structured interview approach was adopted, with a series of pre-determined questions to facilitate the discussion within the group to ensure a rich volume of information was obtained, whilst remaining flexible to allow for new directions to be taken (Creswell, 2003). Participants were encouraged and prompted to fully discuss points raised throughout the interview. Pre-identified questions were developed through an inductive process aligned to the constructivist grounded theory approach (Charmaz, 2006). Questions were generally grouped into the following four areas: EPA as an object (for example, Did you find the EPA meaningful and clear?); Learning outcomes (for example, Do you feel as if the EPAs advanced your learning?); EPA processes (for example, In what way did the EPAs help your understanding?); Practicalities and outcomes (for example, Do you believe you are prepared to perform sport and exercise

Table 1
Student perceptions of the EPA and competency matrix process.

Student perception criteria	Median response grade (IQR)	Strongly Agree (%)	Agree (%)	Slightly Agree (%)	Slightly Disagree (%)	Disagree (%)	Strongly Disagree (%)
Q1: Did you find the competency assessment relevant to the module?	5 (5-6)	35	52	3	3	7	0
Q2: The competency assessment uses language that is easy to understand	5 (4.5-6)	38	38	17	7	0	0
Q3: The competency matrix clearly defined the included areas	5 (4-5)#	21	35	41	3	0	0
Q4: The competency matrix helped me understand this module?	5 (4–5.5)*#	24	28	45	3	0	0
Q5: The competency matrix enabled me to develop my autonomy?	5 (4-5)#	21	41	35	3	0	0
Q6: The competency matrix and assessment was well communicated to me?	5 (4-5)#	21	31	28	14	7	0
Q7: The competency matrix describes tasks that are observable?	5 (4-5)	17	38	31	10	3	0
Q8: The competency assessment and matrix was useful?	5 (4-5)	17	38	35	10	0	0
Q9: The competency assessment and matrix is realistic to achieve?	5 (4-6)	28	41	24	7	0	0
Q10: The competency matrix is a fair way to assess my development	5 (5-6)#	35	45	14	3	3	0
Q11: The competency matrix describes work that is essential to the profession?	5 (4-6)	27	41	28	3	0	0
Q12: The competencies in the matrix are distinguishable from each other?	5 (4-5)	17	35	35	14	0	0
Q13: The competency matrix describes tasks that are measurable?	5 (4-5)#	17	41	35	3	3	0
Q14: The competency matrix can be applied to other Sport Science modules?	5 (4-5.5)#	24	48	21	7	0	0
Q15: The matrix reflects multiple competencies and abilities?	5 (4-6)	31	31	35	3	0	0

Note: Not all percentages sum to 100% due to rounding to 0 d.p; * indicates statistical difference (p = 0.008) between students who were and were not aware of the competency matrix; # indicates statistical difference (p < 0.05) between students who did and did not the competency matrix.

science assessments?). The data collected in the questionnaires and focus groups were analysed and themes were identified for further exploration to create a richer level of detail.

2.1. Data analysis

The median and interquartile range were calculated for questionnaire items with Likert scale responses, with higher scores ($\geq$3) indicating a positive response to the statement. Frequency of the responses were calculated and presented as percentages in each category and the total positive perception response was aggregated. Qualitative statements from open questions on the survey were identified and used to support the quantitative data on student perceptions. Mann-Whitney U Tests were used to identify if gender, awareness of the competency matrix or knowing the purpose of the matrix significantly affected the perception of the EPA and competency matrix. Significance was set at $\rho < 0.05$. A cluster analysis of the questionnaire responses was used to identify commonalities between responses with the intention of statistically defining questions with similar themes. Membership of specific clusters was identified through the average linkage distance between questions. All statistical analyses were conducted using SPSS v24 (IBM SPSS Statistics, IBM Co., Armonk, NY).

Focus group audio recordings were converted into text using the digital dictation tool in Dragon Professional V15 (Nuance Communications Inc., Burlington, MA) within 24–48 h and the transcript transferred into Microsoft Word (Microsoft Co., Redmond, WA). The lead author checked transcripts for fidelity by reading each one individually whilst listening to the recording. Each transcript was analysed and interpreted following a published and widely used thematic analysis framework (Braun & Clarke, 2006). A content analysis (Hsieh & Shannon, 2005) of the identified themes was conducted to determine the frequency of responses and identify the most common perceptions and issues identified by the students.

3. Results

3.1. Perceptions of the EPA and competency matrix

In total, 29 students (response rate 64%) completed the questionnaire to assess their perceptions and thoughts on the EPA and competency matrix (n = 29, mean age 20.1 $\pm$ 3.4 years; males: n = 19, 66%, mean age 19.9 $\pm$ 2.5 years; females: n = 10, 34%, mean age 20.4 $\pm$ 4.8 years). Twenty-six (90%) students stated they were aware of the EPA and matrix and 24 (83%) stated they understood its purpose. Student perceptions of the EPA and competency matrix were overall positive with the median score of 5 (Agree) for all questions (Table 1.).

The majority of students considered the competency matrix easy to understand (93%), clearly defined (97%), well communicated to them (80%), and the listed competencies were distinguishable from each other (87%). This was supported by qualitative student comments, for example;

"Very clear and easy to understand." (S1; Male)

"Clear instructions, sufficient explanations." (S5; Female)

"Yes, the instructions and criteria were very clear." (S20; Female)

However, not all students felt that the competency matrix was clear and useful primarily due to the lack of time provided to understand the matrix and its role in the module. This is reflected in two specific comments;

"Initial pressure to understand content quickly. Pressure eased." (S19; Female)

"Pressuring at first but the pressure did easy after a little while." (S20; Female)

Though it can also be noted from these two comments, that given time and familiarisation with the competency matrix, the students became comfortable and this aided their understanding.

Ensuring the competencies and EPA are relatable to the students and that they can identify how they fit within the module are important in developing its use as an effective teaching and learning tool. The students indicated that the matrix described tasks that were observable (86%), realistic to achieve (93%) and clearly measurable (93%). This was highlighted in student comments;

"Yeah [sic]I understood what the purpose was and why it was there." (S5; Female)

"Yes, sufficient time to meet deadlines." (S19; Female)

"Yes, it helped me understand what tests are used for what the results mean." (S24; Male)

In addition, students thought that the EPAs and matrix reflected multiple competencies and abilities (97%) indicating the EPAs have appropriate range and scope and are an authentic and fair way to assess development of students' professional attributes within the module (94%). This is supported by comments such as;

"Good way to evaluate progression throughout." (S18; Female)

"Engaging helps to identify skills to be competent." (S27; Male)

However, this was not uniformly accepted by all, with one student stating that they "*didn't see progress through.*"

The majority of students indicated that the matrix described work that was essential to careers in Sport and Exercise Sciences (96%) and that it can be applied across the programme in other topic specific modules (93%) - *"Yes, as it helped understanding of the role of a sport scientist and what is expected."* (S2; Male). Finally, the students also thought that the EPA and matrix helped develop their sense of autonomy (97%). This is potentially the most important indication of the success of the application of EPA to Sport and Exercise Sciences as a key outcome is to enable future work with minimal to no supervision. Specific qualitative comment for the questionnaire support this;

"Yes, as it helped understanding of the role of a sport scientist and what is expected." (S2; Male)

Despite the mainly positive comments, there were some negative responses, and these generally related to issues not directly aligned to the EPA or competency matrix but should still be taken into account to create a holistic understanding of the module as they may have implications to the future application of EPAs. These comments included;

"Too much [sic], sometimes it confuses you." (S6; Female)

"Wasn't told about the presentation and report until quite late on - not much time." (S12; Female)

"There was enough time for the booklet however not as much for the report." (S12; Female)

"I didn't like completing the booklet it was time consuming and repetitive." (S13; Male)

Further analysis of the student perception data was conducted to identify if differences in responses occurred due to either sex, or awareness/purpose of the competency matrix. No significant differences in any of the 15 questions was observed between males or females in the cohort ($\rho = 0.94$–0.85). Significant differences in the level of certain responses were observed if the student indicated that they were not aware of the matrix (n = 3, 10%) or did not understand the purpose of the matrix (n = 5, 17%). Where students stated they were not aware of the matrix, the Likert scale response for Q4 was significantly ($\rho = 0.008$) lower for those students who were unaware (3.33) compared to those who were aware (4.85). Responses were significantly lower for Q3 [4.00 vs 4.87, $\rho = 0.037$]; Q4 [3.80 vs 4.87, $\rho = 0.024$]; Q5 [4.00 vs 4.91, $\rho = 0.044$]; Q6 [3.20 vs 4.70, $\rho = 0.009$]; Q10 [4.20 vs 5.22, $\rho = 0.036$]; Q13 [3.80 vs 4.83, $\rho = 0.026$] and Q14 [4.20 vs 5.04, $\rho = 0.049$], when the student indicated that they did not understand the purpose of the matrix.

A cluster analysis was conducted on the questionnaire to identify commonalities between responses with the intention of statistically defining questions with similar themes. Table 2 presents findings from the cluster analysis. Outcomes indicate the membership of each question in to one of three distinct clusters, graphically represented in the dendrogram presented in Fig. 1. The dendrogram displays the three clusters based on the distinct linkages, the first separation (from the right-hand side is seen at the third level, creating a cluster (1) comprising Q1, Q2, and Q6. The second separation occurs at the fourth level, creating a cluster (2) comprising Q3, Q4, Q5, and Q8; and a cluster (3) comprising Q7, Q9, Q10, Q11, Q12, Q13, Q14, and Q15.

The questions in cluster 1 generally relate to the layout and use of the competency matrix, while the questions in cluster 2 generally relate to how useful the competency matrix, though with the additional inclusion of the question relating to autonomy. Cluster 3 includes a wider range of questions however these can still generally be classified around the alignment of the competencies to the professional attributes and to the definitions of EPAs, along with practical factors of the matrix as a tool (i.e. measurable/observable).

3.2. Focus group thematic analysis

Twelve distinct categories were identified within the focus group interviews (Table 3) and these fall into three themes: Pedagogic Attitude to the EPA (Categories 1–4); Normative Beliefs (Categories 5–8); and Factors that Affect the Pedagogic Use of EPA (Categories 9–12). Additionally, an un-coded category was included that captured any other comments not aligned to the themes. These were primarily generalised comments agreeing or disagree or were about the assessment process. The frequency of these were collected (n =

Table 2
Cluster membership of the EPA perception questions.

Question	Cluster
Q1	3
Q2	3
Q3	1
Q4	1
Q5	1
Q6	3
Q7	2
Q8	1
Q9	2
Q10	2
Q11	2
Q12	2
Q13	2
Q14	2
Q15	2

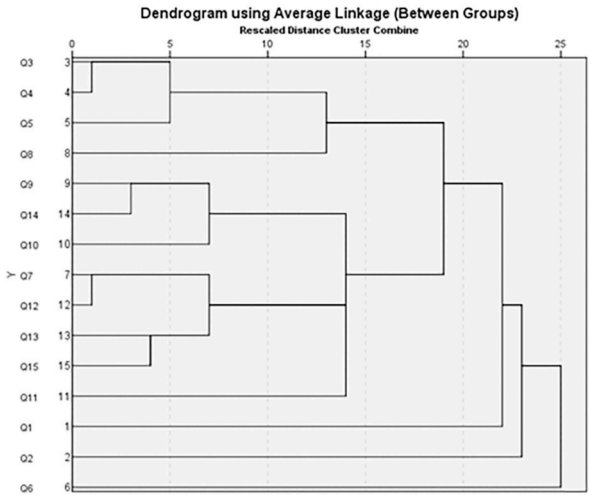

Fig. 1. Cluster membership of EPA perception questions.

Table 3
EPA focus groups: Categories, descriptions, and frequencies.

Theme	Category Number	Category Label	Category Description	Frequency
Pedagogic attitude to the EPAs	1	Personal attitude	Aligns the EPA to their own world view	4
	2	Development	EPA to improve their own academic practice	27
	3	Client focused	Instrumental in supporting quality of the support provided to a client	4
	4	Health and Safety	Health and safety risk to themselves or others	3
Normative Beliefs	5	Influence on their relationships	Impact (positive or negative) on their relationships with the peers or staff within the classrooms	4
	6	Effectiveness	Impact on student behaviour/effectiveness/how worthwhile	8
	7	Social Influence	Individuals, groups or organisations who approve or disapprove (friends and relations, UK government guidelines, sport professionals, clients)	1
	8	Role expectation	Employers expectation as part of the job role	10
Factors that Affect the Pedagogic Use of EPA	9	Barriers	Factors that can make it more difficult to achieve	13
	10	Facilitators	Factors that can make it easier to achieve	12
	11	Motivation	Student willingness to engage in the process	5
	12	Support	Materials, information and expertise availability and structure	12
	13	Un-coded	Anything not in above categories	9

9), as per the process for thematic analysis, but were discounted from further analysis or discussion.

3.3. Pedagogic Attitudes

Development of their own academic practice was the most commonly cited influence of the EPA and competency matrix (n = 27). Participants usually suggested that the EPAs were positive vehicle to aid their academic development.

> *"It helped understanding of the role of a sport scientist and what is expected."* (S2; Male)

> *"But knowing the competencies require it helped you step forward and by the end we knew massively more what we needed to do and what way of working would be better."* (S6; Female).

> *"It almost encourages independent learning so you are not always having to rely on the email and the lecturer like three out of seven days a week. You can refer to that and get where you and what you need to look for."* (S2; Male)

> *"The competencies were one of the most important parts. So having them in bite-size chunks that is how I work best and is how to complete a good athlete test."* (S24; Male)

One of the key reasons for the positive view was highlighted in the first focus group due to the repeated mention of the competencies and how they related to the tasks performed in class. This reinforced the role of EPAs within personal development.

> *"I feel like it has been repeated so many times it has been ingrained in what we need to do. Sometimes when we do something wrong we know we have done something wrong because we know what is expected of us."* (S1; Male)

"Having you demonstrating it, so you knew what competencies you were being asked to do, so you knew what you actually had to do so it was easier when you were doing the test, you knew what was expected of you. And we knew because you had explained it." (S6; Female)

One student indicated that they have taken the competencies forward and are utilising it in a sport science support role they subsequently acquired, showing the benefit of the early implementation in the degree programme at Level 4, rather than waiting until a later stage.

"Because it helped me introduce myself to the work. Because what is important right now as I have gone home and am using it now in a role." (S17; Male)

This early implementation was further supported by another student who indicated understanding the competencies would allow them to build their knowledge in subsequent years.

"I think as you go through them the next couple of years there will be more detail added on to the first year. But these now, I learnt a lot." (S27; Male)

Furthermore, students thought that the EPA and competencies directly influenced the support they were able to perform or would perform in a real-world setting

"I treated it as if it was a professional athlete. So in terms of how I was trying to speak to the client." (S24; Male)

"Again, it's related to taking it forward. Obviously it's good to have good client care." (S6; Female)

A key element to the EPA was to consider health and safety in class and during tests and this was identified by the students

"It actually got us to think about how we conduct these experiments in a safe way as well. Very practical as well." (S1; Male)

Finally, it was interesting to note that the students were able to align the competencies with their own sense of what they expected a sport scientist to be required to do

"Allow you to apply your personality to it and how you would lead." (S6; Female)

Though this was not always clear at the beginning of the module for all students

"When I started the module I wasn't even aware of that that these skills wouldn't even come in to play." (S27; Male)

3.4. Normative Beliefs

Normative beliefs are related to groups, individuals or systems that people believe may affect something and this was reflected in the responses provided by students on how the EPA and competencies are viewed in terms of their use. The most common influence on students was their expectation of what the role of a sport and exercise scientist was and how the competencies would be viewed by employers in the future, especially in job interviews. For example;

"I thought it was good so I could understand what was required when you become a sport scientist, like stuff you would actually take forward and what it needs" (S6; Female)

"Because like it has given us a standards of what is expected of us as sports scientists. And if we hadn't had then then we could potentially be operating sub-par or below what would expected of us in the industry." (S2; Female)

"It would be great because it would be something to talk about within an interview of an example of practice." (S27; Female)

In fact, the link to future careers was explicitly stated as an important issue by the students

"Like the communication and stuff, having the extra like column on it, that is what you would look for if you were employing some one, so I found that really useful." (S12; Female)

"It was more relatable in ways that when you are actually working in the job and its more relatable to that career." (S6; Female)

Other sources of influence were other students in the class

"So if it was me being the sport scientist, so I would talk to them so if they had any anxiety I would try to reduce it. So rest their mind basically." (S27; Female)

Though not knowing other students effected how they applied the competencies

"Over the first few weeks when we didn't know each other we weren't as confident." (S6; Female)

An important area that students indicated that influenced their perceptions of the role of EPA and competencies was how effective the process was

"I think because it is straight forward and it is easy to follow, and you knew what was needed to be done. There wasn't any areas where we thought that wasn't clear, and that made it very practical for us." (S1; Male)

"Then it would be good to take a step back and work on them and when the assessment come it gives you a chance to bring it all together." (S27; Male)

Factors that Affect the Pedagogic Use of EPA.

A number of factors were identified as potential barriers and facilitators to implementing the EPA and competencies in the Level 4 Sport & Exercise Science module. One of the key facilitators was the way in which the competency matrix was communicated to the students as this improved their understanding and application

"I thought it was quite helpful, it was the layout it was easy to follow and know what you had to do." (S6; Female)

"It was fairly self-explanatory, it was something I could work from independently, we weren't constantly coming asking for help. We could just look at it and everything was set out and we could do it ourselves." (S2; Male)

"I like it how you had the statements across the top and down the side, they were like the key features of what is required to be a good sport scientist." (S6; Female)

And the competencies were linked directly to what was required in each test

"So we knew from the lab books and stuff what was expected, so you knew what specific things you were going to be looking for, which practical you were actually doing." (S12; Female)

"Having all the competencies laid out allow us to know the basics, of course depending on which module it works, it creates a foundation to build on." (S27; Male)

Additionally, students indicated that the constant reminder of the competencies aided in the understanding of what was required

"It was constantly it always reminded us. For example, when you do the same test in a different way, like the vertical jump test, you were very clear on point things out or highlighting why it would be a good trial." (S24; Male)

While barriers included a lack of consistency and short time frame to understand the competencies to the fullest extent

"So you didn't get that consistency." (S24; Male)

"We did it for a short time of the year so it was hard." (S17; Male)

Furthermore, the focus on the competencies was seen as a negative as it meant that the student was unable to attend to other elements of the module as clearly

"From my own personal experience it was more focusing on what the test could do for the athlete and having less focus on the competencies. Because I felt sometimes I'd get home and I could have done that or I forgot that. The competencies were at the forefront of my mind." (S27; Male)

4. Discussion

The aim of the study was to explore learner perceptions towards entrustable professional activities implemented within an undergraduate sport and exercise sciences learning environment. In general, students perceived the EPAs and competency matrix to be positive, with a median Likert score of 5 (agree) for all questions. Student perceptions can be separated into three distinct themes: 1. Structure of the EPAs and matrix; 2. Appropriateness as a teaching and learning tool; and 3. Alignment of EPAs and competencies. The most salient point raised by the students was the fact that the competency matrix was easy to understand, with clearly distinguished statements and was overall, well communicated. This indicates that the competency matrix is a well-structured teaching and learning tool that enables sport and exercise sciences students to utilise it with minimal barriers to its application. The students indicated how the EPAs and competencies provided clear alignment to the overall discipline of Sport & Exercise Sciences and their professional development of attributes and skills. Indeed, 96% of students agreed that the competencies described activities that are essential to practitioners in the discipline. Alignment of the competencies within the module to the BASES Accreditation criteria (UK body overseeing Sport and Exercise Sciences) increases the external validity of the EPAs and competency framework developed.

This was further reinforced during the focus group interviews, as students stated that the competencies helped them understand the requirements of the role of a sport and exercise scientist. This is highly important from a pedagogic viewpoint, as we are trying to develop proficiency across a range of disciplines, whilst exposing the cohort to realistic experiences that will ensure they are work-ready upon graduation (Tsitskari et al., 2017; Smith, 2019) and improve their employability (Tomlinson, 2008; Sleep & Reed, 2006). By highlighting the competencies early in the academic process, this allows students to become fully aware, promote ownership of their learning experience (Khanna & Mehrotra, 2019) and can help them self-monitor progress (Ten Cate & Taylor, 2021). This early exposure provides learners with time to develop a rounded academic and professional profile and set goals that can enable the development of desired graduate attribute of learner independence (McNeil et al., 2012).

A key focus of EPAs is ensuring patient or client safety and learners' greater awareness of appropriately designed EPAs can enable safer care. In the present study, some references to client safety and health and safety issues were raised by students in the focus group and open-ended comments in the questionnaire but were not as widely articulated as one might expect. In other disciplines such as pharmacy, 99% of students agreed with the EPA statement that their role was to 'minimize adverse drug events and medication errors'

(Pittenger et al., 2019). Student nurses reported that the use of EPAs enabled them to provide more holistic and patient-focused care (Lau et al., 2020). Pearlman et al. (2017), found that programme directors assessed that only 38% of first year medical residents could perform the following EPA without supervision 'Identify system failures and contribute to a culture of safety and improvement.' Employers considered patient safety the most challenging EPA to assess and encouraged its emphasis as an EPA in undergraduate medical education (Pearlman et al., 2017). Inclusion of a specific question on how the EPA might impact client safety may have enhanced the quantitative questionnaire to determine how prevalent the under-recognition of this aspect of practice was in sport and exercise students.

It must be noted that even after graduation, disparities in the perception of the capabilities exist between graduates and employers that could have implications once a student is employed. For example, differences in perceptions to perform EPA by medical interns was reported by Winn et al. (2018), who found that experienced hospitalists perceived that first-year interns were only able to complete five out of 11 EPAs identified by the Association of American Medical Colleges. In contrast, residents' self-reports indicated a mismatch in that they perceived that they could complete nine out of 11 EPA when they were first year interns (Winn et al., 2018). Pearlman et al. (2017) also reported that programme directors perceived a significant number or residents were not adequately prepared to perform specific EPAs identified by the Association of American Medical Colleges (ranged between 38 and 98%). It is hoped by introducing the competencies and EPA early to undergraduate teaching, it will develop an enhanced understanding and a more realistic self-perception in the longer term.

The perceptions identified in this study reflect those reported on previously on EPA and competency-based education (Pittenger et al., 2019; Lau et al., 2020). The high learner agreement that EPA are aligned to the professional role of a sport and exercise scientist is similar to that reported by Pharmacy students that the selected EPA were relevant (>94% agreement) and represented activities that students would have to perform as entry-level practitioners (>90% agreement) (Pittenger et al., 2019). Furthermore, students indicated that the level of ability to perform EPA increased as they progressed from first year (rated 2 out of 5) to fourth year (rated 4 out of 5) of study. This reflects the agreement that EPAs facilitate the ability to work autonomously within Sport and Exercise Sciences and aids learning of independent student behaviours. Commendation of the structure of the EPA framework (Lau et al., 2020) is similar to our findings that the positive perceptions that the competency matrix was clearly designed and distinguishable, resulting in 93% of students feeling that the EPA and competencies were easy to understand. Findings of initial learner unease about the EPA framework employed by Lau et al. (2020) that resulted in confusion and eventual transition to understanding and relief reflects similar concerns expressed in the current study. This involved initial pressure to understand the competencies quickly, but a gradual reduction in this uncertainty was evident through familiarisation. This indicates that a key component to the introduction of EPAs into Sport and Exercise Sciences must include detailed explanation of the purpose and approach of EPA to the students at an early stage of a module to enhance the pedagogic benefits to teaching and learning.

Significant differences in student perceptions existed when students lacked awareness of or understanding of the purpose of the EPA and matrix. Students reporting a lack of awareness of the EPA and matrix were less likely to recognise its contribution to their understanding of the module or the benefit to their learning. Similarly, students who reported not understanding the purpose of the EPA and matrix were less likely to find that it helped understanding, aided autonomy, was a fair way to assess the module, described tasks that are measurable, or could be applied to other modules. A small proportion of respondents were unaware of (10%) or did not understand the purpose (17%) of the EPAs, and this was likely due to not attending the first week of classes in which the EPA and competency matrix were introduced. It would be understandable that these students did not have as positive feelings about the EPAs as beneficial to their learning. This is reflected in the fact that those that did not know the purpose also felt that it was not well communicated to them. This suggests that even if time is taken to describe the EPA to students, this should be repeated at least a further time to catch students who have missed the first session, and this should be built into future planning and application. Duijn et al. (2017) and Branfield Day et al. (2020) highlighted the importance of meaningful feedback from trusted and credible sources that are timely and frequent in nature as important factors for student learning and development through integrated EPAs. Credible, developmental, and timely feedback may also influence students' knowledge of how EPAs relate to their academic study and may help overcome some of the issues highlighted and augment intended learning outcomes.

4.1. Issues & limitations

In the current study, the EPAs were not related to specific tasks but were designed to cover the tasks included in the module and develop practical skills aligned to professional role requirements (Bradley et al., 2022; Ten Cate & Taylor, 2021). In practical terms, the students focused on the competency statements within each EPA, rather than the EPA as defined by Ten Cate (2013), but rather sub-activities. This is likely due to the academic level of the students rather than issue with the EPAs utilised in the current study. Making time to clearly describe and discuss the EPAs and competencies with the class can help overcome confusion and improve understanding, a fact highlighted in the student responses to the questionnaire and focus groups. The questionnaires were designed to produce an overview of the student perceptions of the EPA and competencies. Whilst two peer reviewed tools are available to assess the quality of EPA statements (QUEPA: Post et al., 2016; EQual: Taylor et al., 2017), no such tool or questionnaire exists for understanding learner perceptions. Instead, the questionnaire utilised in the current project was developed from the ground-up based on a previous questionnaire on student perceptions of marking rubrics (Bradley et al., 2020). Additionally, the questionnaire response rate of 64% may result in a positive bias in the findings of the study, as it is possible that those students who had a negative experience of the EPA were those who were less likely to respond to the questionnaire. As such, the outcomes of the questionnaire should be considered with this potential bias in mind. While the original research plan was to conduct focus groups with 4–8 students per group, the disruption to the study due to Covid-19 and closure of the University resulted in smaller group sizes. It may be considered that the groups of one or

two students may not be recognised as true focus groups but are more akin to semi-structured interviews. However, the researchers endeavoured to follow a focus group format, enabling the participants to fully express themselves through a naturalistic conversation. Furthermore, this was an outcome of the unforeseen changes to the landscape and the research team attempted to minimize the impact of the changes onto the students' responses. Another issue with EPA frameworks in this subject is that Sport and Exercise Sciences is a discipline with a less clearly defined and more variable career pathway once qualified than seen in health care professions such as physiotherapy, nursing, or pharmacy. In addition, in practice there are not always clear or structured supervisory systems as evident in health care professions. This emphasises the importance of ensuring practitioner autonomy and competence through undergraduate studies and real or authentically simulated placement opportunities in a broad range of settings encompasses sport performance and health. Such authenticity may be achieved through working closely with sports teams, local clubs, or fitness and health clubs, with embedded tasks that integrate observed supervision from academic staff and feedback opportunities from coaches or athletes.

5. Conclusion

An EPA framework, based on the BASES Accreditation competency profile, was implemented into an introductory Sport and Exercise Sciences module. Students generally perceived the EPA and competency matrix to be positive. The competency matrix was considered easy to understand, with clearly distinguished statements, and well communicated. As such, EPAs present a well-structured teaching and learning tool that enable student use with minimal barriers to application. Additionally, the EPAs and competencies provided clear alignment to the overall discipline of Sport and Exercise Sciences and the development of core professional attributes and skills in students. EPAs offer a valuable approach to develop work-ready graduate Sport and Exercise Scientists with a clear understanding of the requirements of the role and expected professional standards. Outcomes from this study offer insight into how the implementation of EPAs into an existing pedagogic structure may influence student engagement and understanding and highlight how student perceptions are vital to the success of their implementation. Obtaining student feedback and understanding student feelings attitudes and perceptions towards pedagogic innovations and curricula design changes is crucial to student satisfaction, especially in the new 'students as consumer' higher education era and should be fundamental to all future teaching and learning development strategies.

Author contributions

Authors contributions: EB conceived the study, participated in design of the study, data collection and analysis, and drafted the manuscript. MM participated in the design of the study, data analysis, and assisted in draft and review of the manuscript. LB and DA participated in data analysis, and assisted in draft and review of the manuscript. All authors read and approved the final manuscript and agree with the order of presentation of authors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jhlste.2022.100402.

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