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Development of a Measure of Self-Efficacy Specific to Statistics Courses in Sport

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Abstract

The difficulties that sports studies students report regarding learning statistics typically manifests itself in low self-confidence to succeed. The purpose of the present study was to develop a measure of self-efficacy based on competencies identified by students as desirable for successful performance. Level one sport studies students (N = 130) were asked to describe competencies needed for success on a statistics module. Content analysis identified 44 meaningful competencies describing six factors: lecture behaviour; using information technology; motivated behaviour; time management; statistical theory and a general competencies factor. These competencies were written into a 44-item questionnaire. Future research should investigate the relationships between scores of self-efficacy and performance.

Keywords: self-confidence, measurement, student performance

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Introduction

Sport studies courses typically involve modules in research methods and statistics. Knowledge of how data are gathered and analysed is often a necessary condition for critically analysing research. Students need to know how results are derived for conducting analyses of their own research and for interpreting findings from the literature. These skills are needed in a number of different modules and importantly, tend to form a large component of a dissertation taken at level three of an undergraduate degree. Anecdotal evidence suggests that sport studies students typically find statistics a difficult subject to learn. Their behaviour would suggest that they are low in confidence to succeed. Low confidence might partly be due to their varied background in terms of mathematics experience. Students typically steer towards sport-related courses out of an interest in sport, health and leisure rather than a desire to learn statistical skills. The relevance of learning statistics to developing critical thinking skills is not immediately apparent to many sport students. Teaching statistics to sport studies students represents a serious challenge for lecturers. The purpose of the present study was to develop a measure of self-efficacy based on competencies identified by students as needed for successful performance on a statistics module.

Self-efficacy is defined as the levels of confidence individuals have in their ability to execute courses of action or attain specific performance outcomes (Bandura, 1977; 1982; 1997). Self-efficacy expectations are proposed to influence initiating behaviour, how much effort will be applied to attain an outcome and the level of persistence applied to the task in the face of difficulties and setbacks (Bandura, 1997). Research findings show that high self-efficacy is associated with successful performance, although the strength of relationships tends to vary between studies. This finding has been evidenced in the context of sport (Moritz et al., 2000), academia (Multon et al., 1991; Lane and Lane, 2001; Pajares, 1996), and work (Stajkovic and Luthans, 1998).

A particular variable influencing the strength of relationships between self-efficacy and performance measures is how self-efficacy is measured (Bandura, 1997; Lane and Lane, 2001; Moritz et al., 2000; Pajares, 1996). Self-efficacy measures should assess confidence estimates to perform behaviours required to deliver the actual performance. Thus, self-efficacy research should involve a thorough examination of the competencies that underpin performance.

Lane and Lane (2001) found that self-efficacy predicted performance among postgraduate students. They developed a self-efficacy measure by asking lecturers who taught on the module and students studying on the module to list competencies they believed would be needed to achieve success. They found that having the intellectual ability to cope with course content, and being able to manage time were the most important competencies. However, Lane and Lane (2001) found that self-efficacy predicted only 11 per cent of performance variance. It is argued that a more detailed examination of factors that influence performance should correspond with an increased proportion of performance variance explained by self-efficacy measures.

The purpose of the present study was to identify measures of self-efficacy that tap into the perceived capability of the full range of behaviours of interest.

Method

Participants

The participants were 130 undergraduate sport studies students (male: N=82, female: N=48; age range: 18–31 years) taking a level one module in Research Methods and Statistics at a university in the West Midlands, United Kingdom. The sample represented 79 per cent of all students registered on the module. The majority of participants were full-time students who had fulfilled the entrance criteria for registering for a degree. Participants were heterogeneous in terms of academic experience. Some

participants had entered the university with three high-grade GCE A Levels, others had BTEC National Diplomas, while others entered the university having taken an access course.

Measures

Identification of important competencies related to success on the module

Themes of competencies needed to be successful on the course were developed by asking participants a single, open-ended question 'what do you believe are competencies you think you need to be good at to do well in this module?'. Participants were asked to identify and describe the competencies in as much detail as possible.

Development of a self-efficacy measure

The next step in the research was to use competencies to develop a self-efficacy measure. The phrase 'how confident are you in your ability to [insert competency]' was used as the basis for developing the self-efficacy measure. This approach is consistent with previous research (Bandura, 1997). It was proposed that participants should rate their confidence using a five-point scale. It is acknowledged that Bandura (1997) has used a 100-point scale (1-100) to assess confidence, arguing that efficacy estimates are best assessed using a rating scale analogous to a percentage. It was decided to anchor no confidence around the number zero. Logically, participants should find it easier to understand that zero refers to no confidence at all, rather than a score of one refers to no confidence at all.

Procedures

In the first week of a 15-week module, students were asked to participate in some research that might help improve the module. Students were given access to a module outline that described the aims and objectives of the module. It also contained the marking criteria for assignments and described the skills needed to pass the module. These skills were specific to the research methods module, such as knowledge of statistical theory. The skills were also more transferable in nature, such as using information technology. The module outline could be accessed by students using an online learning website. This meant that all students could access the module outline even if they failed to attend the lecture. As students with limited knowledge of information technology might struggle to get the module outline from the website, a seminar on using information technology was conducted in week two of the module.

During week three, students were asked what competencies they believed were needed for success on the module. It is suggested that students had acquired at least a basic knowledge of the requirements of the assessment needed to pass the module. An open-ended questionnaire was used to identify factors perceived by students to be associated with success in the module. For example, students were encouraged to describe competencies needed to succeed in great depth. It was stressed that there were no right or wrong answers. Participants were assured of absolute confidentiality, each completing the questionnaires alone.

The resultant questionnaire (see Appendix A) was administered to participants in week four. All participants were treated in accordance with the ethical standards of the American Psychological Association.

Data analysis

Qualitative data were analysed using content analysis. Content analysis is a quantitative technique for analysing qualitative data by use of, for example, frequency counts of words, statements, or concepts. The purpose of content analysis is synthesising ideas expressed by participants into a set of integrated themes (Jackson, 1995; Tesch, 1990). Guiding the process is a search for patterns of similarity across the raw data themes, to group similar ideas together. The first stage of the process of analysing data was to identify raw data items, such as using computers, dealing with statistical theory, and managing time. The second stage was to group together raw data items with similar meaning into higher order

themes. As trustworthiness is important when conducting content analysis, all three authors independently conducted a content analysis. Following this, a consensus analysis was conducted by the first author (Tesch, 1990).

The second stage of the study involved investigating the validity of participants' responses to the resultant questionnaire. Alpha coefficients were used to assess internal consistency of each factor. A .70 criterion for acceptable internal consistency was used, as suggested by Tabachnick and Fidell (1996). An accepted limitation of this approach is that the participants used to derive the model through qualitative analysis, were also used to assess the model using quantitative analysis.

Results

Content analysis

The content analysis identified 44 different competencies perceived as needed for success on the module. These competencies were grouped into logical units (see Figure 1), leading to the development of a six-factor model. The first theme comprised four competencies. These items described competencies such as remaining focused on content throughout the lecture and listening carefully in order to pick out key points throughout lectures, and was labelled 'lecture behaviour'. The second theme comprised six items related to using computers and computer software packages such as the Statistical Package for the Social Sciences (SPSS). The theme was labelled 'using information technology'. The third theme comprised six items and was labelled 'motivated behaviour'. Examples of the comments made included 'motivating yourself to read extra research around the topic area' and 'keeping trying, even if you don't fully understand, and remaining enthusiastic about your work'.

The fourth theme comprised six competencies related to 'managing time' such as organising time and getting work completed on time. The fifth factor comprised 16 competencies; examples included correctly analysing data, selecting the important results, and getting to grips with what the numbers mean. It was labelled 'statistical theory'. Factor six comprised six items, with examples including remaining patient, getting information from textbooks, and passing the module. This factor comprised competencies that did not logically belong with other themes and was therefore labelled 'general competencies'.

Internal consistency

In the present study, the Self-efficacy Toward Statistics Questionnaires (STSQ) were administered to the same students in week four. Internal consistency coefficients were acceptable for using information technology (alpha = .89), motivated behaviour (alpha = .80), time management (alpha = .75), statistical theory (alpha = .92), general competencies theme (alpha = .72) and lecture behaviour (alpha = .62). As alpha coefficients are influenced by a combination of the strength of the average inter-item correlation and the number of items, lecture behaviour should score the lowest alpha value as the factor has only four-items. While alpha coefficients show some evidence of internal consistency, it should be noted that the same sample was used to find the factors and test their internal consistency.

Discussion

The present study aimed to develop a measure of self-efficacy to assess competencies perceived as needed for success on an undergraduate sport studies statistics module. A qualitative approach, using an open-ended questionnaire was used to identify competencies perceived as being important for passing the module. These competencies were analysed to yield six themes, namely, lecture behaviour, using information technology, motivated behaviour, time management, statistical theory, and general competencies. These themes were developed into a 44-item self-efficacy questionnaire. Internal consistency results provide some support for the psychometric integrity of the proposed themes.

Theoretically, it is argued that the factors should be interrelated, but also show some degree of independence. For example, being confident toward lectures might show no relationship with confidence toward using information technology. It is suggested that lecture behaviour, using information technology, motivated behaviour, and time management should logically be related to knowledge of statistical theory. Students who concentrate during lectures, manage their time outside lectures, and can work independently using information technology are likely to acquire sufficient confidence in theoretical knowledge to pass the course.

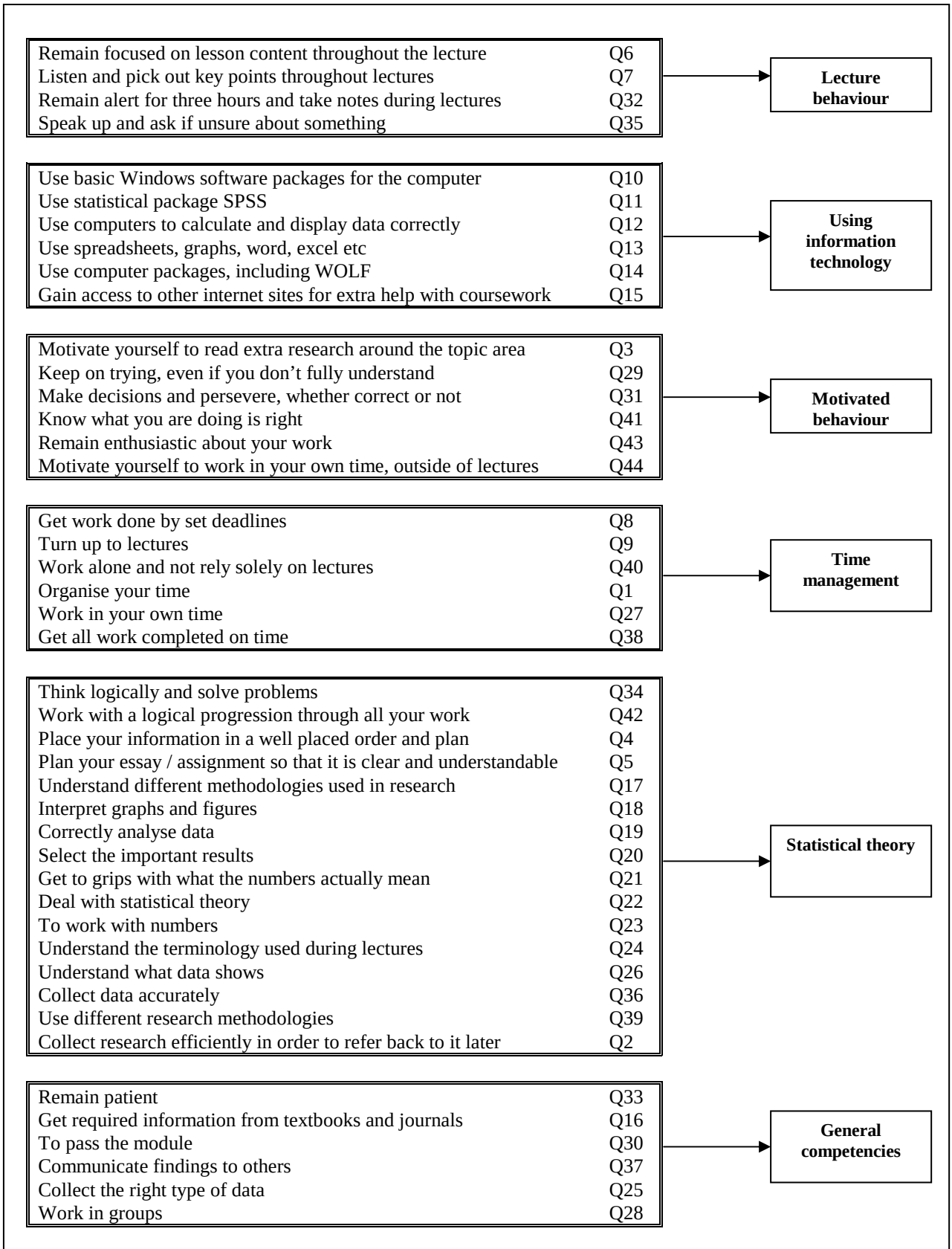
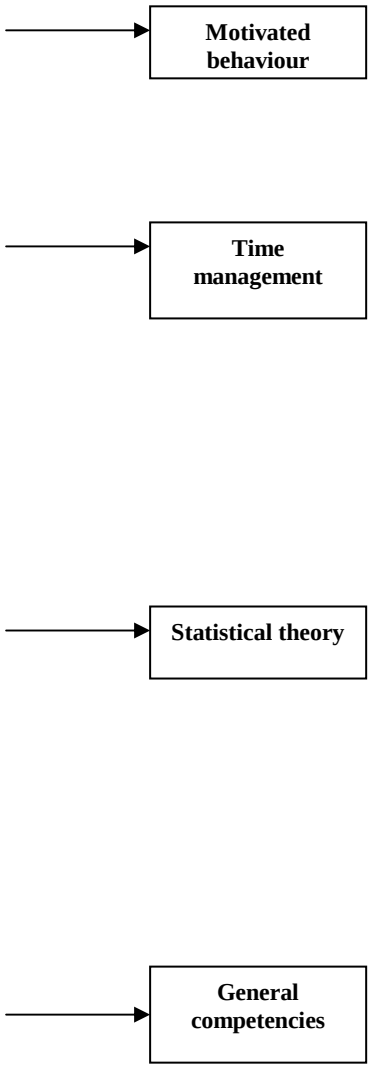


Figure 1: Competencies perceived as needed for success in statistics



Confidence in using information technology is also proposed to be a vital factor for success on the module used in the present study. The course assessment requires students to provide evidence of use of SPSS. The emergence of the factor termed using information technology might be a consequence of how the module is taught. The module is supported by an online learning package which allows students to access module information, including the module outline and assessment criteria, as well as lectures and worksheets related to the assessment.

Students are also taught and encouraged to use SPSS to analyse data rather than calculating it long hand. The move toward encouraging students to analyse data using statistical software packages has increased with the growing demand for students to use information technology. However, it is likely that statistics modules at other universities do not rely so heavily on information technology. Some lecturers believe that students should learn to calculate statistics by hand, thereby learning to use formulae underpinning each test.

We suggest that the STSQ might provide useful information for assessing the effectiveness of teaching and learning during a statistics module. For example, it would be desirable for students to report high scores on the factor 'confidence to remain focused during lectures'. This would suggest that students are concentrating and using the lecture time to learn. By contrast, if students reported low scores on lecture behaviour and statistical theory, it would suggest that students are struggling to follow information delivered in lectures. Lecturers could use this information to modify how the module is delivered.

Low scores for time management suggest that students are struggling to manage the demands of university life. Lane and Lane (2001) identified a similar factor in their study of postgraduate business studies students. They argued that the costs of fees increased the likelihood of students taking part-time jobs. Balancing the demands of a full-time course with the demands of a part-time job can be difficult. Although undergraduate modules typically run in the daytime, leaving time available in the evening for part-time work, it is the evening when students can access learning resources more easily. In the day, gaining access to a computer terminal can be difficult as the demand for a terminal is relatively high. Thus, for students who have to balance full-time study with part-time work, the ability to concentrate in lectures becomes a very important factor because students need to maximise the limited time available.

Although findings from the present study show face validity and internal consistency, there is a need for further validation studies. Researchers are indebted to investigate the validity of measures and the application of research to practice depends on the availability of valid measures. If measures are not valid, results cannot be emphasised (Anastasi and Urbina, 1997; Kline, 1993). An accepted limitation of the present study is that quantitative analysis was conducted on the same sample used for qualitative analysis. Schutz and Gessaroli (1993) cautioned researchers about reusing participants from the same sample to cross-validate results. Evidently, there is a need to cross-validate the factor structure identified in the present study to a new sample of students taking research methods and statistics.

Conclusions

In conclusion, the present study explored competencies needed for success on a statistics module. A 44-item questionnaire was developed. It is suggested that researchers use this questionnaire to assess confidence to succeed on a statistics module. Future research should investigate the factorial validity of the measure. It is suggested that confirmatory factor analysis should be used to test the hypothesised factor structure identified in the present study through content analysis. A second line of research is to assess the relationship between scores on the Self-efficacy Toward Statistics Questionnaires (STSQ) scale and academic performance on statistics modules. There is a third line of research. If the STSQ shows factorial and predictive validity, it might be possible to develop an empirical basis for interventions designed to enhance performance through changing perceived self-

efficacy. Collectively, we suggest that identification of efficacy expectations toward factors relevant to performance might lead to improved performance.

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Appendix A

Self-efficacy Toward Statistics Questionnaire (STSQ)

Item		Not confident at all				Very confident
1	How confident are you in your ability to organise your time?	0	1	2	3	4
2	How confident are you in your ability to collect research efficiently in order to refer back to it later?	0	1	2	3	4
3	How confident are you in your ability to motivate yourself to read extra research around the topic area?	0	1	2	3	4
4	How confident are you in your ability to place your information in a well placed order and plan?	0	1	2	3	4
5	How confident are you in your ability to plan your essay / assignment so that it is clear and understandable?	0	1	2	3	4
6	How confident are you in your ability to remain focused on lesson content throughout the lecture?	0	1	2	3	4
7	How confident are you in your ability to listen and pick out key points throughout lectures?	0	1	2	3	4
8	How confident are you in your ability to get work done by set deadlines?	0	1	2	3	4
9	How confident are you in your ability to turn up to lectures?	0	1	2	3	4
10	How confident are you in your ability to use basic Windows software packages for the computer?	0	1	2	3	4
11	How confident are you in your ability to use statistical package SPSS?	0	1	2	3	4
12	How confident are you in your ability to use computers to calculate and display data correctly?	0	1	2	3	4
13	How confident are you in your ability to use spreadsheets, graphs, word, excel etc?	0	1	2	3	4
14	How confident are you in your ability to use computer packages, including Wolf?	0	1	2	3	4
15	How confident are you in your ability to gain access to other internet sites for extra help with coursework?	0	1	2	3	4
16	How confident are you in your ability to get required information from textbooks and journals?	0	1	2	3	4
17	How confident are you in your ability to understand different methodologies used in research?	0	1	2	3	4
18	How confident are you in your ability to interpret graphs and figures?	0	1	2	3	4
19	How confident are you in your ability to correctly analyse data?	0	1	2	3	4
20	How confident are you in your ability to select the important results?	0	1	2	3	4
21	How confident are you in your ability to get to grips with what the numbers actually mean?	0	1	2	3	4
22	How confident are you in your ability to deal with statistical theory?	0	1	2	3	4
23	How confident are you with your ability to work with numbers?	0	1	2	3	4
24	How confident are you in your ability to understand the terminology used during lectures?	0	1	2	3	4
25	How confident are you in your ability to collect the right type of data?	0	1	2	3	4
26	How confident are you in your ability to understand what data shows?	0	1	2	3	4

27	How confident are you in your ability to work in your own time?	0	1	2	3	4
28	How confident are you in your ability to work in groups?	0	1	2	3	4
29	How confident are you in your ability to keep on trying, even if you don't fully understand?	0	1	2	3	4
30	How confident are you in your own ability to pass the module?	0	1	2	3	4
31	How confident are you in your ability to make decisions and persevere, whether correct or not?	0	1	2	3	4
32	How confident are you in your ability to remain alert for three hours and take notes during lectures?	0	1	2	3	4
33	How confident are you in your ability to remain patient?	0	1	2	3	4
34	How confident are you in your ability to think logically and solve problems?	0	1	2	3	4
35	How confident are you in your ability to speak up and ask if unsure about something?	0	1	2	3	4
36	How confident are you in your ability to collect data accurately?	0	1	2	3	4
37	How confident are you in your ability to communicate findings to others?	0	1	2	3	4
38	How confident are you in your ability to get all work completed on time?	0	1	2	3	4
39	How confident are you in your ability to use different research methodologies?	0	1	2	3	4
40	How confident are you in your ability to work alone and not rely solely on lectures?	0	1	2	3	4
41	How confident are you in your ability to know what you are doing is right?	0	1	2	3	4
42	How confident are you in your ability to work with a logical progression through all your work?	0	1	2	3	4
43	How confident are you in your ability to remain enthusiastic about your work?	0	1	2	3	4
44	How confident are you in your ability to motivate yourself to work in your own time, outside of lectures?	0	1	2	3	4