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Students´ Understanding of Theory in Undergraduate Education

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Abstract

The paper investigates undergraduate students´ application of theory in their analysis of problems presented in authentic leadership cases. Taking a phenomenographic research approach, the paper identifies two levels at which students understand "theory": Level 1-- Theory as knowledge acquired from books; Level 2--Theory as support for problem solutions. Only the students at Level 2 understanding achieved the highest learning outcome described by the Bologna Reforms. This result may be accounted for by the difference in the students' pre-conceived understanding of the events and relationships in the analysed cases.

The phenomenographic assumption explains why the authentic cases are problematic. The high relevancy of the learning object – as an authentic case – may reduce the effect of variation, in this case the educational environment that is the mechanism for learning according to variation theory. The use of the authentic cases creates a conflict between relevance and variation.

Introduction

The Bologna Reforms, adopted in Sweden in 2007 (Regeringens Proposition 2004/05:162), prioritize alignment of course goals as learning outcomes, the use of appropriate teaching methods and the assessment of student performance. Teachers should address differences in students' pre-understanding (in this paper, "everyday understanding") of course content by offering preparatory courses and using selection processes for course admissions. Neglect of differences in students' learning capabilities may affect their learning outcomes.

It is difficult in a programme or course to influence how students understand the reality in which they live (i.e., the highest level of understanding per the Bologna Reforms). Teachers must understand how students learn (Denzin and Lincoln 2005). Previous research shows that students who use different learning approaches (surface and deep) may achieve different learning outcomes (Marton and Säljö 1976a, 1976b). We argue that students' different levels of understanding and their use of academic concepts about lived experience present a fundamental problem for teachers who aim for coherence between students' academic learning and the research process (see Ramsden 2003).

We take a phenomenographic research approach (Marton 1981; Marton and Booth 1997). Our focus is undergraduate students' ways of understanding learning objects. Methodologically, this approach uses hierarchical systems that categorize students' qualitatively different ways of understanding the critical aspects of the learning objects (Marton and Tsui 2004). Specifically, using problems from authentic cases (i.e., the students' professional experience), we investigate how students understand the critical aspects of "theory" and "analysis" in practical problems in analysis tasks.

We analysed six students' solutions to managerial problems in written examinations. We also analysed their interview descriptions of how they reached these solutions. Our research questions are: What are the various ways of understanding a "problem analysis" [the students' analysis task]? Is there a connection between the various ways of understanding an analysis task and the teacher's evaluation of the student's solution?

We used a stratification process to select students for the research. We wanted a student sample that would reflect the three possible achievement levels in the course examinations.

The students, all of whom were healthcare professionals, were enrolled in a healthcare management programme. In such programmes, students typically have a well-developed and heterogenic pre-understanding (an "everyday understanding") of the issues in their courses. This situation is probably an upcoming situation in more and more programmes. Understanding of the meaning of the concepts of "theory" and "analysis" may be regarded as of general relevance to all courses.

Theoretical framework

The focus of this study is the meaning-making students exhibit in their solutions to an analysis task. The students are expected to identify new aspects in leadership situations that previously they were unable to discern. Co-workers or leaders regard these leadership situations as problematic. To discern these new aspects, a change (i.e., growth) in the students' thinking is necessary. They have to use new tools to discover new meaning.

Many learning theories have developed from the extensive body of research on how students learn. How do we understand a new learning object? What happens when we think and construct the meaning of a learning object?

We refer to John Dewey's (1910/1991, 116) description of the relationship between meaning and growth as the theoretical touchstone for our study:

> To find out facts just as they stand, mean, is the object of all discovery; to find out what facts will carry out, substantiate, support a given meaning, is the object of all testing. When an inference reaches a satisfactory conclusion, we attain a goal of meaning. The act of judging involves both the growth and the application of meaning.

Drawing a conclusion, according to Dewey, is a judgement act that involves both 'growth and the application of meaning'. If 'growth' means a change in the way a learning object is perceived, then the conclusion ascribes meaning to that object. In this study, we interpret 'growth' as the result of change in how theory, derived from books, becomes an analytical tool that can be used to solve practical problems.

Following this line of reasoning, we investigated the qualitatively different ways students understand learning objects. Traditionally, the aim of phenomenographic research is to investigate what it means to experience an object in a particular way (i.e., how to constitute a relationship with learning objects [Marton 1981]). Thus, phenomenographic research is grounded in a non-dualistic ontology. Every aspect the student discerns of the learning object corresponds to a certain dimension of variation (Marton 1981; Marton and Booth 1997; Rovio-Johansson 1999). A subsequent development of phenomenographic research focuses on the differences between student answers, that is, in the alternative ways of discerning the same learning object (Pang and Marton 2003).

In phenomenographic research, the researcher focuses on the qualitative differences in the students' answers. The goal is to categorize students' understanding of phenomena (Marton 1981). This analysis results in several categories of description, often hierarchically related. At a "lower" level, the student may discern specific aspects of the learning object; at a "higher" level, the student may take a holistic view of the learning object.

Variation theory is a development of the phenomenographic research approach. The variation in the students' understanding of the learning object is expressed by different learning outcomes. The teacher focuses on different aspects of the learning object, one aspect at a time, so that students discern the varied aspects against an invariant background.

Marton and Booth (1997, p. 145) argue that learning is learning to experience: 'If the relevance structure of the learning situation is the driving force of learning, its chief mechanism is variation'. Students' previous experience creates their relevance structure. However, if students think their previous experience alone prepares them to understand a situation, there is no driving force that makes them try to learn more about the learning object. Therefore, it is argued, variation of the learning object is needed to challenge students' taken-for-granted ideas, based in such previous experience. Marton and Booth (1997, 145) continue: 'It is through variation that aspects are differentiated within the experience of a phenomenon'.

Using the phenomenographic research approach and variation theory, we argue that students can learn to apply what they have studied by taking responsibility for their own learning. This student-centred point of view, however, may be problematic as far as the learning outcomes promoted by

the Bologna Reforms, especially when student groups have heterogeneous cultural and ethnic backgrounds as well as different experiences and skills.

Background: The course, the analysis tasks and the assessments

The course

Organization and Management in Healthcare is the first course in the part-time, healthcare management programme at the School of Public Administration, the University of Gothenburg. The course is for employed healthcare professionals enrolled in programmes in medicine, public health or other social sciences. They are primarily nurses, psychologists, occupational therapists or physiotherapists (ages 35 to 40; many are middle managers).

The course, consisting of six lectures and two seminars, begins with an introductory lecture on management theory followed by formative episodes in which students analyse each other's authentic cases. This course structure gives students the opportunity to use theory as an analytical tool to solve the kinds of management problems they are likely to encounter as managers and co-workers. Thus, the course has a practical as well as a theoretical aspect. Specifically, the course is designed to teach students *organization theory as a research area* and the use of *theories as tools* for the analysis of typical situations, events and relationships in the healthcare environment.

The lecture on management theory relates to various kinds of organizations. The course literature is Jacobsen and Thorsvik's (2000) *Hur moderna organisationer fungerar* [How modern organizations work] and Siverbo's (2007*) Demokratisk och effektiv styrning –En antologi om forskning i offentlig förvaltning* [Democratic and effective control – An anthology of research in public management]. The theory lecture addresses the following question: *What is a theory?* The teacher explains that theories can improve our understanding of the world, and that management theory, when used to understand managers' and co-workers' actions, can justify as well as change organizations' actions.

The analysis tasks

In their course examinations, students are presented with analysis tasks that require them to propose solutions. The pedagogic goal is that students will "weave" theory and practice in their

solutions. For practice, it is recommended that at the beginning of the course students attempt to solve a problem that is similar to the analysis task that will be required in the examination. For this preliminary task, students write a short case description and analysis of an actual problem based on their everyday understanding of management practices. In their discussion of each other's cases, students describe the use of theory as a tool that provides additional insights into everyday understanding. These are the formative episodes. Then, in small groups, the students engage in an analysis task that requires them to answer questions related to theoretical concepts in healthcare (e.g., *What are your organization's goals? How would you describe these goals?*)*.* After the small group discussions, students participate in plenary sessions where a few groups report their ideas. The purpose of this analysis task is to show students the practical relevance of theory to organizational issues.

The teacher provides students with the following guidelines on how to conduct the analysis tasks. Students are told to write a management case that deals with a problematic work situation, event or relationship that has resulted in a less than positive outcome. In their analysis, students should link the situation to a management theory from the course lectures or literature. Their analysis should also discuss the theoretical concepts in the case. For example, if the case concerns trust – or the lack of it – then the theory should deal with the importance of trust in the workplace. In this way, the students "weave" theory and practice.

In addition, students should explain the cause and effect mechanism of theory by using their selected theory to resolve the problematic situation, event or relationship. In the analysis, students should demonstrate their understanding that theory should be used to solve the problem. If the theory is normative, the students may propose recommended solutions. As appropriate, students may relate the analysis to their personal experiences in the conclusion of the analysis.

In the end-of-course examinations, students were asked to analyse a new problem or to use an expanded version of their course case analysis. Again, students are expected to choose a theory, or theories, to support their analysis. They should relate the results of the analysis to their everyday understanding and should draw conclusions about how management processes/problems in the practical context of healthcare should be dealt with. The examinations thus relate to the course goals

that are consistent with the goals of the Bologna Reforms: the attainment of certain *skills* and *abilities* and the promotion of certain *values* and *attitudes.*

The assessments

It challenging to design assessment methods for students who have worked in healthcare management and whose opinions are influenced by such work. They are inclined to analyse management situations from a practical perspective instead of a theoretical perspective. Typically, because they lack a foundation in theoretical knowledge, they base their analyses on their everyday understanding. Because of these factors, specific grading criteria were set for the examination analysis tasks.

First, we describe the possible examination evaluations in terms of the three recommended outcome stages from the Bologna Reforms: 1. knowledge and understanding; 2. skills and abilities; and 3. values and attitudes.

To earn a *pass* grade, students had to meet the following criteria:

1. Knowledge and understanding: Students must describe classical and modern organizational theories: their basic principles and applications.

2. Skills and abilities: Students must compare and rank these organizational theories relative to their applicability to the control of organizations.

3. Values and attitudes: Students must identify the theories used to analyse management processes/problems in the practical context of healthcare management, evaluate the results of this analysis in relationship to their everyday understanding, and draw conclusions about the application of these results in practice. Students must also demonstrate recognition of the need for further managerial knowledge and be able to explain how such knowledge is acquired.

Students who met some of these criteria might earn a *barely pass* grade. Students who did not meet any of these criteria received a *fail* grade.

Students who met the following criteria received a *high pass* grade:

1. Students must meet the criteria for a *pass* grade.

2. Students must demonstrate an excellent ability to analyse management processes/problems from independently selected theories and to reflect on the results of the analysis in relationship to personal, practical experience.

These grading criteria confirm to the Bologna Reforms examination requirements (www. Bolognaprocess.net).

Methodology

We were interested in how students understand the concepts of theory and analysis. We wanted to learn the following: What does "theory" mean to students? What does "analysis" mean to students? To answer those questions, we took a qualitative research approach in the interviews as we asked them about theory and analysis.

Selection of students

Six students were selected for the study based on their examination performance on analysis tasks (see Denzin and Lincoln, 2005, on methodology). Two students had *barely pass* or *fail* grades, two students had *pass* grades, and two students had *high pass* grades. These students are identified in this paper as follows: R1 (woman, age 31, hospital employee); R2 (woman, age 53, hospital employee); R3 (woman, age 45, hospital employee); R4 (woman, age 31, healthcare centre employee); R5 (woman, age 46, hospital employee); and R6 (woman, age 35, healthcare centre employee).

A sample of six students does not constitute theoretical saturation. A larger sample might have led to new evidence and different findings. According to Kvale (1996), in interview research, at least 15 interviews are required to draw conclusions. However, based on our performance selection criteria, these six students are representative of the course composition. The students in the programme were 95% women and 5% men. Thus, the selection of the six women students is not skewed from a gender perspective.

Interviews

We conducted our interviews using a semi-structured, conversational interview format. Kvale (1996) states that this interview format is intended to elicit qualitative descriptions of the interviewees' worlds that the interviewer can then interpret. The interviews began with a general conversation on how students view the course. In the conversation, the interviewer first took the role of a teacher posing questions before taking the role of other students in the course who might have difficulty in understanding the concepts of theory and analysis. This procedure permitted a relaxed conversational climate that elicited candid comments from the students.

Two main interview questions introduced themes that were then developed with follow-up questions.

Main question 1: What does the concept of theory mean to you? *Follow-up questions*: What does a theory concern? What does a theory consist of? How is a theory developed? Specifically, how can one use a theory? Can you describe these uses in a different way?

Main question 2: What does the concept of analysis mean to you? *Follow-up questions*: What may an analysis lead to? What does an analysis consist of? Specifically, how can one use an analysis? Can you describe these uses in a different way?

Each interview took between 50 and 60 minutes. All interviews were audio-recorded and later transcribed, resulting in 32 pages of interview data.

The graded examinations

In addition to the interview data, the evidence for this study consists of the six students' solutions for the examination analysis task. The teacher evaluated the examinations according to the grading criteria presented above.

Analysis of interviews and examinations

We analysed this data in two steps. Both steps contributed to the identification and interpretation of two levels of student understanding.

In the *first* step, we took a phenomenographic approach in our analysis of the interview responses. We analysed these responses by taking the students' perspectives in order to identify any differences in their understanding of the analysis task. Our goal was to determine the students' understanding of the concepts of theory and analysis, the reasons for their choice of theory, and their use of theory. The results were categorized on the basis of the qualitative differences in their responses.

In the *second* step, we analysed the students' examination solutions to the analysis task in relation to their interview responses. This step gave us better understanding of how the students approached the analysis task and how they interpreted the concepts of theory and analysis.

Credibility of data

There is a problem with data credibility if interviewees give accounts of what they think are appropriate for the occasion instead of descriptions of lived experiences (Czarniawska 1999). For example, if the interviewer has a notion about the topic raised with the interviewee, it is probable the interviewer will direct the conversation such that it creates learning in the interviewee (Alvesson 2003; Säljö 2005). Furthermore, there may be a power imbalance between interviewer (in our case, the teacher as the researcher) and interviewee (in our case, the student) that causes the interviewee to seek acceptance on the interviewer's terms (Kvale 1996).

To ensure the credibility of our interview data, we framed the discussion by asking students about the facts in their examination responses to avoid giving them opportunity to convey certain appropriate impressions of themselves or their activities (Alvesson 2003). We conducted our interviews as conversations in settings where the students felt comfortable in order to inspire their trust so that they would respond openly (Kvale 1996).

We audio-recorded all the interviews, in order to achieve a high degree of reliability for our analysis and interpretation of the interview data.

Ethical considerations

This research follows the code of ethics for researchers in the humanities and social sciences adopted by the Swedish Research Council in 2011. Therefore, the participants in the study were protected by the generally accepted rules for ethical research (see Kvale 1996). All participants, who were informed of the study's purpose and design, agreed voluntarily to take part in the study. Their anonymity was also guaranteed in the event of publication of the findings. Thus, the participants were assured there would be no negative repercussions to them as a result of their involvement in the study. Generic descriptions are used to identify the participants: for example, woman, age 53, hospital employee.

Results

The results of this study reveal two levels of student understanding (i.e., Level 1 and Level 2). The two levels differ in three important respects: students' view of theory, choice of theory and use of theory. Students at Level 1 analysed the featured phenomenon (the analysis task) using their everyday understanding. Theory had little influence on this understanding. They thought of *theory as knowledge from a book.* By contrast, students at Level 2 used their chosen theory as an integral part of the analysis. Theory enriched the analysis beyond the limits of their everyday understanding. They understood *theory as an explanation of a problem*

Understanding at Level 1: Theory as knowledge from a book

View of theory: Students at Level 1 think of theory as description. In describing organizational theory, a student says: "It is something from a book, a written explanation, a theoretical kind of knowledge." (R2) For another student, the understanding of theory was unclear: " I thought theory worked better at the beginning . . . but at the conclusion I did not think so . . . I had had enough . . . I doubted whether I would use further theory." (R2). A student may even develop a personal theory. One student says: "I believe that for her (the manager in the case] . . . now I am perhaps stating my own theory . . . the situation was certainly not easy when so many people had resigned at the same time, one after another. It is clear that the situation was critical." (R6) Students at Level 1 generally find it challenging to link case details to a conceptual theory. They do not think theory helps with the analysis. One student says: "Yes, it is very hard [to separate personal experience from the analysis]. I am a very analytical person. I analyse everything I do, the least little thing." (R6)

Choice of theory: Students at Level 1 offer case descriptions that do not clearly describe problems requiring solutions. Therefore, theories are needed to elucidate case details (e.g., a leadership case requires a leadership theory). One student says: "Choose a theory that relates to leadership. The theory shouldn't stick out. It should be consistent with the story." (R2) Another student says: "The chosen theory should link management and management style. Try to find a theory that says something about how a manager should act in a meeting." (R5) Theoretical schools that contain whole families of theories are confusing to students. Another student says: "Begin by looking at one of the books in the course, asking yourself if Taylorism is a theory, if organization culture is a theory." (R2) The same student describes the difficulty of finding a theory to use in the analysis: " It is hard to find theories. It is so long since I was in school and had such assignments. Then I could find theories that worked . . . if the theories were explained more clearly, it would be easier, but then that would not be instruction at this level." (R2)

Use of theory: Students at Level 1 first use expanded case description in their theoretical analysis. Then, as they try to reach conclusions, students gradually introduce a mixture of everyday understanding and several theories rather than apply a particular theory. A student says: "I could find things that might agree with. I could look for certain things when I read through theories several times. Then I could answer the questions." (R5) Often, when a theory is selected, it is not used to analyse the case. One student explains: "I described the case, what he [the manager in the case]

should do, what he has done, little things. That was how I analysed the case. I described what went wrong and why it went wrong. Thus, I made the analysis first and used theory last." (R3) Students at Level 1 also find the analysis task difficult and confusing. A student explains: "It is hard to find a theory that you can use. You have to think and then you become confused and finally come to nothing. Then you can't . . . then you almost have to choose among masses of theories . . . that isn't such a good plan either." (R4)

Understanding at Level 2: Theory as an explanation of a problem

View of theory: Students at Level 2 look at theories as explanations of relationships or of events. One student says: "I think you try to explain something with the help of theory. You try to understand why something happens." (R1)

Choice of theory: Students at Level 2 look for a theory that explains the problem rather than look for superficial similarities between the theory and the problem. A student states: "You look at the essential elements in a situation. You can describe the situation in detail, but three sentences may describe the problem you want to analyse--for example, someone's behaviour. I think that theory should be able to explain why the problem exists and why people behave as they do." (R1) Students may reject alternative theories when such theories do not provide a solution to a problem. A student explains: "When I first looked at the case [before choosing a theory], I didn't understand the problem. We didn't want her [the manager in the case] to make a change in her work. That was our view of her leadership. The conflict was the problem, not the change in the work that she wanted to make." (R1) The only difficulty students at Level 2 have is in the identification of an appropriate theory. Once a theory is identified, its use is straightforward if the theory points to the relevant aspects of the case. The theory leads to a conclusion that the students can relate to their everyday understanding.

Use of theory: Students at Level 2 introduce theory immediately in their analyses and use theories as explanations. Thereafter, they develop their analyses using theory that is relevant to their explanation. A student states: "In my analysis of a case, I look at how the analysis task [in the case] is structured [a question to be answered based on theory]. I found I had given work procedures for the case to my group that were very clear so everyone knew what he or she should do. Then I could say

the analysis task was structured. " (R1) Students at Level 2 refine their case descriptions in order to answer the questions that theory raises and use theoretical concepts to understand problems. In this way, they find it rather easy to match the phenomena in a case with a theory. Concerning the difficulty of making this linkage, a student states: "I thought it wasn't hard. It was amazing. I felt I had made the right connection. I thought it was a rather simple task to find the sentences that matched the theory." (R1) Thus Level 2 students use theory to discover connections and patterns in their cases instead of looking for correspondences between elements in the cases where everyday understanding is used without theory.

Summary

According to the phenomenographic research approach (Marton 1981), the students' collective and hierarchical structure for the *conception of theory* consists of three levels of understanding: in order, from C, the lowest category of description, to A, the highest category. Students in Category A, which includes the lower B and C categories, means they have identified knowledge elements and have analysed related elements.

Categories	Theoretical knowledge elements
A	Understanding coherent elements
B	Analysing related elements
C	Identifying elements

It is possible to relate the previously discussed two levels of understanding to these categories of descriptions. Students at Level 1, *Theory as knowledge from a book,* chose, a theory with a superficial similarity to a concept in the case. This corresponds to Category C. Students at Level 2, *Theory as an explanation of a problem*, chose a theory that links and explains elements. This corresponds to Categories A and B. Based on these correspondences, we conclude there are two groups with a collective qualitative and hierarchical difference in understanding. Students advance from Level 1 to Level 2 when they learn to identify and relate theoretical knowledge elements.

Conclusions

This study shows that students at the two levels of understanding approach an analysis task quite differently. The main difference results from their view of the importance of everyday understanding in solving problems. Students at Level 1 rely mainly on such understanding; students at Level 2 are willing to expand that everyday understanding to include theoretical understanding.

However, we observed no difference between students at the two levels in their general understanding of the concept of analysis. While both groups understood they were to analyse the problem and present a reasoned solution, they analysed different aspects of the problem.   Level 1 students merely developed the factual description in the case; Level 2 students applied theory to the analysis of the case.

The study also led us to question the effectiveness of the use of authentic management cases. We selected such cases because we assumed that learning is influenced by learners' experience of reality. According to Marton and Booth (1997), little learning takes place if students are presented with unfamiliar situations, events and relationships. In three respects our study challenged this assumption.

First, an authentic leadership case does not create a relevance structure. When students encounter a familiar problem, they may believe their previous experiences are sufficient to understand it. Then there is no driving force that causes them to modify or enlarge their everyday understanding by using theory (Learning Object 1) in support of their analyses.

Second, the phenomenographic approach assumes there is a relationship between the learner and the learning object. As a consequence, learning involves a change in the perception of the learning object. In this study, the students were instructed to use analysis (Learning Object 2) in their problem solutions. However, we found it is difficult to change the perception of a learning object that is recognised due to earlier experience. A student expresses this idea as follows: "You can be a little too involved in it [the case for analysis]. Then it is difficult to be impartial."

Third, variation in the education environment or the workplace is insufficient (a) to challenge pre-conceptions about problems and (b) to challenge everyday understanding of the problems. It is difficult to overcome these challenges.

Theoretical implications

Phenomenography offers 'a way of describing intended or actual outcomes of learning' (Marton and Booth 1997, 135). This means, 'the competence achieved due to learning is the competence to experience various phenomena in certain ways that reflect the changing person-world relations and that evolve as a function of experience' (Ibid.).

The student's capability to experience a change of the phenomenon's relevance structure demands that something vary and change. When presented with an analysis task that had similarities to their workplace tasks, the students' first response was to use their everyday understanding to explain their solution instead of using theory to support their solution. Despite their presence in a learning situation where they were encouraged to use theory as a tool in problem solving, the students used their "common knowledge and practical experience". As the relevance structure of the analysis tasks increased, the influence of variation in aspects of the problem decreased. We conclude that the high relevance structure of familiar cases can reduce the effect of variation in learning situation. Accordingly, the structure of relevance and variation are not independent aspects for learning objects.

Practical implications

Teachers should recognize that students' understanding of a learning object may differ from their own. Instead of taking-for-granted that students' understandings agree with theirs, teachers should discover and encourage differences in understandings. Teachers can use student interviews, such as those in this study, to identify students' everyday understandings. In this way, they can observe how students view, choose and use theory.

A student's everyday understanding can be enlarged to include theoretical understanding by the learning process. However, teachers need not reject everyday understanding or replace it entirely with theoretical understanding. Nor should teachers accept that everyday understanding is constant or coexistent with a different theoretical understanding. A discussion of the various meanings of theory, not only as *knowledge in a book* but also as *tools for understanding*, *explaining and drawing conclusions*, can enhance the value of theoretical understanding vis à vis everyday understanding.

Students may derive greater benefit from the analysis of management cases that differ from the real life situations they have experienced. They are likely to analyse situations more objectively if they have no personal interest in the problems. Therefore, teachers may assign students cases that their classmates have prepared rather than ask them to analyse their own experiences. A Level 1 understanding among students may have negative consequences for achieving defined learning outcomes. If students do not achieve understanding of the concepts of theory and analysis, teachers should modify their teaching methods so that they are more suited to the goals of the Bologna Reforms.

To advance from Level 1 to Level 2, the student must achieve a theoretical understanding of studied phenomena. The teacher's role is to help students make this transition by explaining the relevance of theory to a problem or issue. The teacher must first observe how students' everyday understanding may have produced misconceptions about how theory is used to understand evidence. By using a mini-study, as in this research, (see Results), teachers can observe this Level 1 understanding among students. At this level, students have simply identified theoretical knowledge elements and have not progressed to their analysis. Contradictory evidence can be used to challenge everyday understanding.

Limitations of the study

A larger sample size could identify more than two levels of understanding. Even with our small sample, data from the interviews and the examination responses suggest there may be sublevels of understanding. There may also be explanations for the differences in these data sources.,

Future research

Our study was conducted in an introductory, undergraduate course for healthcare professionals. We cannot claim our results apply to more advanced courses (either undergraduate or graduate) in other subjects. Moreover, the students in our study were a homogenous group of professionals of the same nationality and with similar work experience and training. It would be interesting to conduct similar research with groups of students in other courses, at other academic levels, and/or with greater diversity in their education, experience, culture and training.

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