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EPISTEMICALLY TUNED-IN?

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ABSTRACT

Existing research from several decades indicate that students' deep learning does not always evolve as expected within higher education. Further, there is consensus that so-called epistemic beliefs influence the way students learn.

The purpose of the current study is to explore the epistemic beliefs of students entering higher education, and to investigate if their epistemic beliefs differ across study programmes. This information is the basis for future research about a possible connection between epistemic beliefs and deep learning with the purpose of supporting deep learning approaches within higher education.

The data was collected using a web-based survey about epistemic beliefs among 521 new students representing a broad variety of study programmes. The results reveal statistically significant differences in the epistemic mind-sets of the students across the study programmes although, at the time of data collection, students had not yet been exposed to any kind of pedagogical influences. Thus, the results suggest that the students seem to have "tuned in" their epistemic mind-sets prior to entering the university.

This pilot study focuses on describing the differences, but does not shed light on the reasons and background for them. The results raise questions for further research such as: How exactly and why do the epistemic mind-sets differ across and within study programmes? To what extent do students tune in to adequately match their own epistemic mindsets with the programme or subject specific epistemologies? Is an epistemic change a possible way to enhance deep learning?

INTRODUCTION

Deep learning is broadly regarded as the essence of higher education. However, in a review study covering 43 longitudinal studies published between the years 1977 and 2016, Asikainen & Gijbels (2017) describe that less than half of the studies reported a positive development of the deep approach. These findings are in line with the anecdotal evidence provided by teachers that some students learn successfully and exhibit signs of a deep learning level, whereas some students simply "don't get it" and seem to learn only on a superficial level.

At Arcada University of Applied Sciences, we have been conducting research on the so-called epistemic beliefs and observed a large variation in them on a general level. Furthermore, there is a wide consensus that students' epistemic beliefs influence the way they learn (e.g. Lee, Liang, & Tsai, 2016). This suggests that a connection between epistemic beliefs and learning success should be investigated. Importantly, a better understanding of students' epistemic beliefs could generate potential ideas for how to support or facilitate deep learning.

THEORETICAL BACKGROUND

Learning within higher education has often been explored using theories and models about learning styles. Over the past years, this branch of research has been criticized (e.g. Kirschner, 2017), opening avenues for alternative approaches. One such approach is the one suggested by Dai & Cromley (2014), focussing on how students' epistemic preferences match with their epistemic beliefs.

Epistemic beliefs dimensions

According to one line of investigation, epistemic beliefs are defined as a person's perceptions and beliefs about the epistemic characteristics of knowledge, and described as a set of dimensions expressing aspects of knowledge, such as knowledge being certain or stemming from an authority. Marlene Schommer introduced the first self-report instrument SEQ (Schommer Epistemological Questionnaire) to capture these dimensions (Schommer, 1990), and described epistemic beliefs as a set of five dimensions labelled Simple/structure of/ knowledge, Certain/certainty of/ knowledge, Source of knowledge/Omniscient authority, Innate ability to learn and Learning speed.

The SEQ instrument and its successors (FEE by Moschner & Gruber, 2017; EBI by Schraw, Bendixen, & Dunkle, 2002; EBS by Wood & Kardash, 2002) were constructed as self-report questionnaires where the items were expressed as bi-directional statements presented on Likert-type scales, where the poles express a

naïve vs. sophisticated orientation. The items were factor analysed to create factors, describing the dimensions mentioned above.

Domain specificity

Using a shortened version of Schommer's SEQ-instrument supplemented with a discipline-focused questionnaire, Hofer (2000) identified disciplinary differences in 1st year students. The domain-specificity of epistemic beliefs has later been largely corroborated (Aditomo, 2018; Iordanou, Muis, & Kendeou, 2019; Muis, Bendixen, & Haerle, 2006).

Epistemic change

The intervention study by Muis & Duffy (2013) shows that epistemic beliefs are malleable. Change can be supported by an appropriate epistemic climate and enculturation, i.e. a process where students' knowledge views adjust to the surrounding perspectives occurring in the social settings of the academic community (e.g. Bråten, 2016; Muis & Duffy, 2013; Trautwein & Lüdtke, 2007). Epistemic change and specifically development of a criterialist stance (as opposed to an absolutist or relativist stance) can also be induced by exposing students to conflicting information, as reported by Mierwald, Lehmann, & Brauch (2018) in the domain of history.

Beliefs, preferences and competence

Dai & Cromley (2014) subscribe to Schommer's definition of epistemic beliefs but as an addition, they introduce the concept of epistemic *preferences*, defined as students' preferences for the epistemological characteristics (e.g. structure or certainty of knowledge) of a subject domain. In their study, they found matching preferences and beliefs to be connected to better achievement in a chemistry course. Besides matching preferences and beliefs, Dai & Cromley also suggest paying attention to match and mismatch between other epistemic components in the learning process, i.e. domain and classroom epistemology.

The results reported by Aditomo (2018) suggest a connection between academic performance and some of the epistemic belief dimensions, depending on the nature of the discipline in terms of hard vs. soft sciences.

During the past decades, the discussion around epistemic beliefs has become broader, deeper and more nuanced, acknowledging for instance that a sophisticated stance is not necessarily superior to a naïve stance. Instead, Grossnickle Peterson et al. (2017, p. 256) introduce the concept of epistemic competence which can be

interpreted as the competence to choose the appropriate epistemic stance depending on subject, task and context.

RESEARCH PROBLEM

As mentioned above, students studying different fields seem to have differing, domain-specific epistemic beliefs already in the first year. Furthermore, there seems to be a connection between academic performance, the domain and epistemic beliefs. Hence, this study seeks to establish:

- What kind of epistemic beliefs do the students hold when entering professionally oriented higher education?
- Do their epistemic beliefs differ across study programmes?

Responding to these questions generates a baseline in preparation for future research (see section).

DATA COLLECTION

Sample

Data were collected among a cohort of new students (N=678) entering Arcada University of Applied Sciences in Helsinki. The students represented 14 bachelor level study programmes, out of which three were offered parallelly in Swedish and English.

Instrument

In this pilot study, we used an extended instrument that was based on previous instruments: in addition to the previously identified four dimensions Omniscient authority, Structure of knowledge, Certainty of knowledge and Learning ability, the extended instrument contained three new dimensions labelled Constructivist approach, Internet reliance and Learning by dialogue (Ståhl, 2019). The dimension Internet reliance was included to capture the googling approach that has raised concern among both parents and educators during the past decades.

The instrument was distributed as a web-based questionnaire containing 40 epistemic statements on a 6-point Likert-type scale ranging from 1 (completely disagree) to 6 (completely agree). The scale also offered two non-substantial options (don't understand and don't know) so as not to compel the respondent to express an unfounded opinion. The 40 items were distributed over nine pages, and page order was randomized in order to mitigate the effects of response fatigue (cf. Cape, 2010).

Each anticipated dimension was represented by five to seven items. The questionnaire items were consistently generic (not domain- or discipline-specific), and the written and oral instructions did in no way refer to relating the responses to any specific subject, academic field or context. In addition to epistemic items, the survey contained items measuring study motivation and critical thinking which are, however, not used in the present study.

Procedure

In order to get a baseline measure of the students' epistemic beliefs, data collection was organised during the very first week of the semester, prior to exposing students to study subjects or pedagogical influences at the university. The students were invited to participate over personal email invitations, and data collection was organised in scheduled sessions in order to have the opportunity to inform the students both orally and in writing but above all, to motivate participation. The students were informed that participation was voluntary but that the purpose was to develop the education they enrolled in. Further, that data was to be managed anonymously as declared in the publicly available privacy notice regarding scientific research (GDPR, 2016, articles 12-14).

ANALYSIS AND RESULTS

Sample and data descriptives

Out of all students, 77% (n=521) completed the survey although on the study programme level, the response activity varied between 53% and 100%. Genders were represented in the sample in the same proportion as in the population, as was the case for the average age (23.8 / 23.1). Compared to the population, domestic students were slightly over-represented in the sample (86.8% / 85.5%).

On item level, the responses ranged over the whole scale (1 .. 6) for practically all 40 epistemic items; only three items collected no "totally disagree" responses. Offering non-substantial response options contributed to a good data quality and to assessing item functionality: only five items exhibited a non-response rate over 7% and in general, the items contained substantial responses to an average of 97%.

Epistemic dimensions

In previous studies, exploratory factor analysis was used for extracting the factors representing the epistemic dimensions (Ståhl, 2019). The replication of previously identified exploratory factor analysis models has, however, often failed (see Schraw,

2013) as was the case with the current material, which excluded the use of factor scores. Instead, we chose to compute subscale scores as unweighted mean scores of the items associated with each subscale. Prior to computing them, we analysed the internal consistencies of the anticipated subscales in order to decide, which items to include in each subscale.

As a result, each dimension was represented by three to six items, altogether 27 items. After this, we used the reduced item set to compute the subscale scores as "qualified" averages using the mean.x function (SPSS, 2016). By qualified average we express that a subscale score value was computed only when the respondent provided enough substantial item responses for that particular subscale, which guaranteed that a subscale score value was never based on a single or very few items. Thus, e.g. the Constructivist approach subscale score required substantial values for at least five out of six items whereas those subscales represented by only three items required all three items to contain substantial values.

Results

The first part of the current research task was to describe the epistemic beliefs of students entering professionally oriented university education. For this purpose, we analysed the distribution of the subscale scores as illustrated in Figure 1.

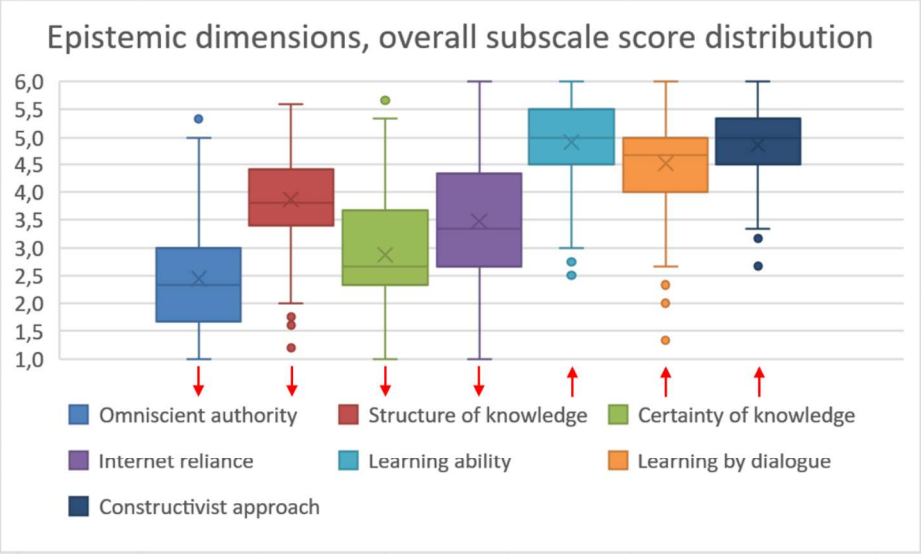

Figure 1. Overall distribution of epistemic dimension subscale scores. Red arrows at x-axis denote the sophisticated orientation for each dimension.

On a general level, the students seem rather sophistically oriented regarding the dimensions Omniscient authority, Certainty of knowledge, Learning ability, Constructivist approach and Learning by dialogue, whereas the scores regarding Structure of knowledge and Internet reliance are more towards the naïve. As was the case with item responses, also the subscale scores are rather widely distributed.

The results above indicate that the mostly sophisticated orientations suggest that in general, the students should be prepared for higher education studies. On the other hand, the wide distribution indicates a strong heterogeneity regarding almost all dimensions, suggesting that some students may regard knowledge in a too naïve manner, less appropriate for higher education studies. The wide distribution also suggests that it should also be possible to identify differences across groups, as anticipated in the second research task.

To respond to the second research task, we explored possible differences in epistemic beliefs across study programmes using the One-way Anova test. The study programmes were entered as independent variables and the subscale score means as dependent variables. Throughout the analyses, a significance level of .05 was used for the statistical tests (Coolican, 2014, pp 570-586; SPSS, 2016).

Table 1.Summary of subscale score means comparison across study programmes using the One-way Anova test.

Subscale	***F***	***sig.***
Omniscient authority (3/3)	*2.482*	*0.001*
Structure of knowledge (4/5)	*2.316*	*0.003*
Certainty of knowledge (3/3)	*1.746*	*0.037*
Internet reliance (3/3)	*3.440*	*0.000*
Learning ability (3/4)	*2.133*	*0.006*
Learning by dialogue (3/3)	*1.493*	*0.098*
Constructivist approach (5/6)	*2.605*	*0.001**

*All df=16; *p<.001*

The results, based on the current material, indicate statistically significant inter-group differences for six out of seven dimensions (Table 1).

DISCUSSION

When building up the instrument presented in a previous study (Ståhl, 2019), we sought inspiration both from Schommer's (1990) original SEQ and from its successors (Moschner & Gruber, 2017; Schraw et al., 2002; Wood & Kardash, 2002). Thus, the study was built on concepts and instruments presented in numerous previous studies within the line of investigation, where epistemic beliefs are regarded

as a set of independent dimensions. This study was the first to test our extended instrument containing new dimensions.

The findings corroborate previous findings regarding early disciplinary differences (Hofer, 2000) and domain-specificity of epistemic beliefs (Aditomo, 2018; Iordanou et al., 2019; Muis et al., 2006). Notable in the current study is that the new students may have tuned in their epistemic mindsets to align with their perceptions of the epistemologies in their fields, prior to being exposed to any kind of enculturation at their study programme or at the university.

Since the sample consisted of new students at a single university of applied sciences, generalizability is limited. The target population, containing students from a broad variety of study programmes, is a strength whereas the linguistic, cultural and geographical distribution is limited. Still, the results are clear enough to encourage further investigation along this line but naturally with a larger population, including students at science universities, from other parts of the country, and also from universities in other countries.

When planning data collection, we acknowledged that achieving enough response activity is an ever-growing challenge. Therefore, instead of publishing a general invitation on some public channel or some open space, we chose to address the students through personal invitations and to organize data collection as scheduled sessions, which proved successful. We believe that the high response activity can be attributed to this procedure. Thus, one lesson learnt from this study, important for all researchers conducting especially web-based data collection, is that, even when collecting data within e.g. an educational institution offering easy access to the respondents, one cannot expect respondents to participate based on an impersonal invitation. High respondent engagement requires addressing the respondents in a more personal way, which in practice implies meeting them face-to-face.

From a technical point of view, the instrument functioned smoothly and as expected, and the page randomization contributed to distribute non-response evenly over all items. Thus, none of the items suffered from considerable non-response.

CONCLUSIONS

Consequences for educational practice

Students having different epistemic mind-sets before they even enter the university is an interesting finding per se, suggesting that already during the process of considering, choosing and applying to a study programme, the students seem to "tune in" their epistemic beliefs.

Further, the broad distribution within study programmes is also a finding, indicating a heterogeneity within the group and suggesting that some students may tune in whereas others may not. Thus, the question is: have they tuned in to the appropriate mode or do some students suffer from an epistemic mis-match, that is, a mis-aligned tuning in relation to the discipline-specific epistemology and the epistemic climate (cf. Dai & Cromley, 2014)?

Identifying new students' epistemic mind-sets may enable choosing interventions for epistemic change (cf. Bråten, 2016; Muis & Duffy, 2013; Trautwein & Lüdtke, 2007). Further, acknowledging the level of sophistication for each dimension for the current context, topic and study level may support the teacher in choosing the appropriate epistemic level and learning activities, i.e. what Dai & Cromley (2014) describe as matching the classroom epistemology.

Further, an epistemic awareness might help the teacher in selecting appropriate pedagogic activities to support the enculturation of students' epistemic beliefs. The pedagogic activities would then be guided by epistemic matching (cf. Dai & Cromley, 2014) and go hand-in-hand with developing the students' epistemic competence (cf. Grossnickle Peterson et al., 2017).

Future research

The findings suggest that the development towards deep learning could be facilitated by having better information about the students' epistemic mind-sets. This would require systematically measuring students' epistemic beliefs with both baseline and follow-up measures.

The results indicate heterogeneity in epistemic beliefs and therefore, future research should explore in more depth how students' epistemic mind-sets differ across and within study programmes, and which background factors may contribute to these differences.

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