Factor analysis of the *Approaches and Study Skills Inventory for Students* in a cross-cultural occupational therapy undergraduate student sample

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Abstract

Introduction: The *Approaches and Study Skills Inventory for Students* (ASSIST) has long been used to assess learning approaches among students in higher education, but reports of its use with occupational therapy students are rare. This study investigated the factor structure of the ASSIST in a cross-cultural sample of undergraduate occupational therapy students, and examined whether the factor structures from specific participant groups from different cross-cultural contexts were consistent with the main pattern.

Methods: Occupational therapy students (n = 712) from education programs in Australia, Norway, Hong Kong, and Singapore completed the ASSIST and provided socio-demographic data. To assess the factor structure of the instrument, a Principal Components Analysis (PCA) using a confirmatory approach was performed. The internal consistency of the scales and subscales was assessed with Cronbach's coefficient α and with inter-item correlations.

Results: For the whole sample, the PCA confirmed the three factors as previously established. Five subscales loaded on the first factor (*strategic* approach). Four subscales loaded on the second factor (*surface* approach), whereas the remaining four subscales loaded on the third factor (*deep* approach). Repeating the analysis for each of the country-specific samples produced slightly diverging factor structures for the samples from Australia and Hong Kong.

Conclusion: Considering all the data, the ASSIST subscales that emerged from the PCA confirmatory approach in this study revealed a good degree of concordance with the established factor structure. The slightly deviating results obtained for the Hong Kong student group indicate that the established factor structure may not be the best fit across all settings and samples.

Keywords: factor analysis, higher education, occupational therapy, psychometrics, students

Introduction

Many factors influence students' academic results in higher education, and there is general agreement that students' own engagement with the curriculum is important for their subsequent grades (Bonsaksen, Brown, Lim, & Fong, 2017; Diseth, 2007; Kusurkar, Ten Cate, Vos, Westers, & Croiset, 2013; Mcdonald, Reynolds, Bixley, & Spronken-Smith, 2017; Salamonson et al., 2013; Valadas, Almeida, & Araujo, 2017). Over the last decades, the "approaches to studying" concept has denoted students' general orientation towards studying in academic settings (Richardson, 2013). According to the original work of Entwistle and Ramsden (1983), three more or less distinct approaches to studying have been empirically identified: the *deep, surface,* and *strategic* approaches. The *deep* approach is described as studying with the purpose of understanding. When studying with a *deep* approach, the student connects and distinguishes between different ideas found in the study materials. Through this process, the course content and the study materials carry personal meaning for the student. The *surface* approach, on the other hand, is described as studying with the aim of passing exams, but without true engagement with the studies. The student hopes to avoid failure while making little effort. The third type of study approach, the *strategic* approach, is described as oriented towards achievement. The student aims at the best possible grade, and organizes study efforts according to that aim (see for example Entwistle & Ramsden, 1983; Richardson, Gamborg, & Hammerberg, 2005).

One of the most frequently used measures for assessing students' approaches to studying is the *Approaches and Study Skills Inventory for Students* (ASSIST; Tait, Entwistle, & McCune, 1998). The ASSIST consists of 52 statements to which the respondent indicates his or her level of agreement. In the analysis stage, the items are structured into three main scales – the *deep, strategic,* and *surface* approaches to studying – and each of the scales consists of four to five subscales. The main scales have been found to predict students'

academic results in a range of studies across various disciplines. In general, *deep* and *strategic* approaches have been associated with better learning outcomes and exam grades among students, whereas a *surface* approach to studying have been associated with worse outcomes (Diseth, 2007; May, Chung, Elliot, & Fisher, 2012; Richardson, Abraham, & Bond, 2012; Salamonson et al., 2013; Subasinghe & Wanniachchi, 2009; Ward, 2011).

Several researchers have documented the psychometric properties of the ASSIST measure. Initially, Entwistle, Tait and McCune (2000) reported from a study involving a sample of 1284 British first-year university students where all of the thirteen subscales loaded on the three theoretically proposed factors. Two subscales loaded on more than one factor. The internal consistency of the subscales were between 0.53 and 0.76, and internal consistency of the main scales was high: 0.84 (*deep* approach), 0.80 (*surface* approach), and 0.87 (*strategic* approach). Kreber (2003) investigated a sample of 1080 undergraduate science students in Canada, and found that all subscales loaded uniformly on the three scales, as expected from the theory. The internal consistency of the subscales ranged 0.59-0.80. Richardson (2005), investigating 2149 students in distance education in the UK, found the same pattern: three main scales, explaining 60.8 % of the data variance, with internal consistency of subscales ranging 0.50-0.82. Investigating accounting students in Ireland (n = 437) and the United States (n = 298), Byrne, Flood, and Willis (2004) similarly found a three-factor solution, explaining 61 % of the variance. However, the analysis also showed examples of cross-loadings and unexpected loadings. Internal consistency was high (0.80-0.87) for the main scales and deemed acceptable for the subscales (0.49-0.77).

Similarly, Valadas, Goncalves and Faísca (2010) and Diseth (2001) found two subscales (of the Portuguese and Norwegian versions of the ASSIST, respectively) to be problematic because of cross-loadings and low communalities. Diseth (2001) omitted the two problematic subscales from further analysis. The remaining subscales loaded as expected on

three factors, explaining 63 % of the data variance. Internal consistency was high for the main scales (0.70-0.81), and mostly acceptable for the subscales (0.49-0.72). Several other studies have similarly confirmed a pattern of high internal consistency for the main scales, and mostly acceptable for the subscales (Ballantine, Duff, & Larres, 2008; Reid, Duvall, & Evans, 2005; Reid, Evans, & Duvall, 2012; Richardson, 2010; Richardson et al., 2005; Valadas et al., 2010).

To our knowledge, only two studies have examined the properties of the ASSIST specifically in an occupational therapy education context (Richardson, 2010; Richardson et al., 2005). Both studies used data from occupational therapy students (n = 221 and n = 401, respectively) enrolled in seven different higher education institutions in Denmark, and concluded that a three-factor structure of the Danish ASSIST was the best fit to the data (65.3 % and 58.0 % variance explained by the factors, respectively). The majority of the subscales loaded on the expected factors.

To summarize, the ASSIST has been extensively examined in factor-analytic studies, and the factor structure consistency of the *deep*, *strategic*, and *surface* scales have been well established. The three ASSIST scales also exhibit high levels of internal consistency and explanatory power (55 % - 65 % explained variance). Eleven of the 13 subscales seem to function according to theory (Tait et al., 1998), whereas two of the subscales have been problematic. The subscales have generally been found to have low internal consistency, but this is considered less of a problem and a natural consequence of only four items being encompassed by each subscale (Kline, 1994). Researching the factor structure of the ASSIST in the context of occupational therapy education is a relatively new phenomenon with only two studies reporting about its psychometric properties in this group of students (Richardson, 2010; Richardson et al., 2005). Across disciplines, only one study have used data collected from two different countries (USA and Ireland; Byrne et al., 2004). As suggested from this

study, using a sample representing a larger number of institutions, and possibly a larger number of cross cultural contexts, may provide a more comprehensive insights into the measurement properties of the ASSIST. Also, as suggested from previous research, using a similar study process measure (Bowden et al., 2015), the associations between the deep and surface study approaches may differ between cultural groups. In some cultural groups, these approaches may be strongly associated, whereas they may be more distinct in others. Taken together, previous research findings give cause to examine the factor structure of the ASSIST in different cultural groups.

Study aims

The aim of the current study was to confirm the currently established factor structure of the ASSIST in a cross-cultural sample of undergraduate occupational therapy students, and to examine whether the factor structures for each of the four specific countries were consistent with the structure obtained for the total sample. A secondary aim was to examine the internal consistency of each of the ASSIST scales.

Methods

Design and setting

The study had a cross-sectional design and took place at four universities in four different countries (Australia, Hong Kong, Norway, and Singapore). The occupational therapy education programs in Norway and Singapore are three-year undergraduate programs, whereas the program in Australia is a four-year undergraduate program. Two programs are run in Hong Kong: a three-year and a four-year program. The participants from Australia were from all four study years (first year n = 170, second year n = 77, third year n = 73, and fourth year n = 56). The Norwegian participants were at all three year levels (first year n = 57, second year n = 50, and third year n = 53). The participants from Hong Kong were

predominantly in the first and third study years (first year *n* = 37, second year *n* = 5, and third year *n* = 23) from the four-year program, and third year students only (*n* = 44) from the three-year program. Lastly, only first year students were included in Singapore (*n* = 67).

Recruitment

Inclusion in the study was based on: 1) students enrolled in the occupational therapy education program at one of the involved universities; and 2) informed consent to participate in the study was provided. A non-teaching member of staff, who distributed the questionnaires to students during breaks between scheduled classes, collected the data in 2015.

Measurement

The students from Australia, Hong Kong and Singapore completed the original English-language ASSIST (Tait et al., 1998), whereas the students from Norway used a previously validated Norwegian translation (Diseth, 2001). The ASSIST consists of 52 statements to which the respondent is asked to rate his or her level of agreement (1 = disagree, 2 = disagree somewhat, 3 = unsure, 4 = agree somewhat, 5 = agree). The instrument has a proposed three-factor structure and the items are organized accordingly into three main scales (the *deep, strategic,* and *surface* approaches to studying) and thirteen subscales (Tait et al., 1998). Four of the subscales reflect a *deep* approach; five subscales reflect a *strategic* approach, while the last four subscales reflect a *surface* approach. Scale and subscale scores are calculated by adding the scores on the relevant items. In addition to the ASSIST, information regarding the participants' age (categorised into age groups: 15-19 years, 20-24 years, 25-29 years, 30-35 years, 36-39 years, and ≥40 years) and gender was collected.

Data analysis

Cronbach's α were used to assess the internal consistency of all ASSIST scales and subscales. With the purpose of confirming the proposed factors latent in the measure, a confirmatory

approach to Principal Component Analysis (PCA) was used. The analysis was performed on a subscale basis, in accordance with the strategy adopted by previous researchers (Byrne et al., 2004; Diseth, 2001; Kreber, 2003; Valadas et al., 2010). The pre-determined extraction of three factors was based on theory and subsequent research (Byrne et al., 2004; Diseth, 2001; Kreber, 2003; Valadas et al., 2010). In addition, we assessed Eigenvalue (λ) estimates and assessed the variance proportions explained by the three extracted factors. Each additional extracted factor should be able to explain at least 10 % of the total variance in the data. As the factors were expected to correlate, a Direct Oblimin rotation method was used in order to obtain a clearer structure matrix. All analyses were performed using IBM SPSS version 24 (IBM Corporation, 2016).

The subscales were expected to load on the three main scales, the latter representing the approaches to studying. Thus, treating the thirteen subscales as items to be analysed, a forced three-factor solution was applied to the data. The analysis was first conducted using the data from the total sample, then with the data from each country separately. The Kaiser-Meier-Olkin (KMO) measure of sampling adequacy (Kaiser, 1974) and Bartlett's test of sphericity (Bartlett, 1954) were used to assess whether these datasets were eligible for factorization. The KMO value should exceed 0.60 in order to proceed with factor analysis (Cerny & Kaiser, 1977; Kaiser, 1974), and Bartlett's test of sphericity should reach statistical significance (Bartlett, 1954). The reported statistical measures include Eigenvalues, communalities (the variance proportion of each variable explained by the three factors together) and factor loadings (estimates of the impact from a given variable on each factor). Factor loadings > 0.60 are generally considered very good, whereas loadings between 0.30 and 0.60 are interpreted as moderate (Kline, 1994). The internal consistency of the scales and subscales were assessed using Cronbach's coefficient α. Two methods were used: i) assessing the consistency between subscales encompassed by each of the scales (higher-level analysis);

and ii) assessing the consistency between individual items encompassed by the scales (lower-level analysis). Statistical significance was set at $p < 0.05$.

Ethics

Approval for conducting the study was obtained from the appropriate Ethics Review Boards/Data Protection Agencies serving each of the involved universities. The students were informed that completion of the questionnaires was voluntary, that their responses would be treated in confidence, and that there would be no negative consequences from opting not to participate in the study.

Results

Participants

The participants in this study were 712 students, representing Australia (n = 376, 52.8 %), Hong Kong (n = 109, 15.3 %), Norway (n = 160, 22.5 %), and Singapore (n = 67, 9.4 %). The sample represented 66.1 % of the total number of students at the four sites. Response rates were for Australia n = 376/410 (91.7%), for Hong Kong n = 109/355 (30.7 %), for Norway 160/245 (65.3 %), and for Singapore 67/67 (100 %). For all of the countries, the largest part of the sample was under the age of 25 years (in the total sample: n = 617, 86.7 %), but the difference in age distribution was statistically significant ($p < 0.001$). Similarly, for all countries, there was a predominance of female students (in the total sample: n = 602, 84.6 %), but the difference in gender distribution was statistically significant between the four countries ($p < 0.001$).

Internal consistency of scales and subscales

First, an initial analysis of internal consistency of scales and subscales was performed, using individual items as variables. Cronbach's α ranged between 0.70 (*surface* approach in the Australian subsample) and 0.85 (*strategic* approach in the subsamples from Australia, Hong

Kong, and Singapore) for the scales, and between 0.35 (*use of evidence* in the Singapore subsample) and 0.82 (*time management* in the Hong Kong subsample) for the subscales.

Psychometric properties of the ASSIST in the cross-cultural sample

Given that the variables subjected to factorization (i.e., the subscales) were each constructed from four individual items, all of them yielded Eigenvalues well above the commonly used threshold value ($\lambda > 1$). Factor 1 had $\lambda = 32.3$, explaining 30.7 % of the data variance. Factor 2 had $\lambda = 16.5$, explaining an additional 15.6 % of the variance in the data, whereas Factor 3 had $\lambda = 12.6$, explaining 12.0 % of the variance (cumulative 58.3 % variance explained by the three factors). The communalities of the items after the extraction of three factors were between 0.29 (*alertness to assessment demands*) and 0.76 (*time management*).

Table 1 shows the factor structure resulting from the PCA with Oblimin Rotation, with factor loadings sorted by size. The three extracted factors explained 58.3 % of the variance in the data. All subscales loaded onto the three factors in line with theory. *Time management, organized study, achieving, monitoring effectiveness,* and *alertness to assessment demands* loaded on Factor 1 (*strategic* approach). *Unrelated memorizing, fear of failure, lack of purpose,* and *syllabus-bound* loaded on Factor 2 (*surface* approach). Finally, *relating ideas, use of evidence, interest in ideas,* and *seeking meaning* loaded on Factor 3 (*deep* approach).

Assessing internal consistency based on subscale scores, Cronbach's α was good for Factor 1 and Factor 3 (0.80 and 0.77, respectively), while only moderate for Factor 2 (0.62). When calculating Cronbach's α based on individual items instead of the subscales, then internal consistency was higher for all factors (Factor 1 = 0.84, Factor 2 = 0.75, Factor 3 = 0.80). The correlation matrix showed that Factor 1 correlated -0.05 with Factor 2 and 0.31 with Factor 3, whereas Factor 2 correlated -0.13 with Factor 3.

[TABLE 1 ABOUT HERE]

Psychometric properties of the ASSIST in the sample from Australia

Table 2 shows the factor structure for the Australian sample, with factor loadings sorted by size. The three extracted factors explained 61.2 % of the variance in the data. Overall, the factor structure was the same as with the total sample. However, two of the subscales that were originally part of the *surface* approach deflected from this pattern. The *lack of purpose* subscale loaded negatively on Factor 1 together with the five subscales that make up the *strategic* approach. The *syllabus-bound* subscale loaded negatively on Factor 2 together with the four subscales falling under the *deep* approach. Internal consistency of the factors, assessed using the subscale scores, were low (0.53-0.62). The correlation matrix showed that Factor 1 correlated 0.26 with Factor 2 and 0.02 with Factor 3, whereas Factor 2 correlated -0.09 with Factor 3.

Given that the *lack of purpose* and *syllabus-bound* subscales also loaded moderately (> 0.40) on the factors suggested by theory, the internal consistency using the originally proposed factor structure was re-assessed. This revealed considerably higher reliability estimates for Factor 1 (0.81) and Factor 2 (0.79), but lower for Factor 3 (0.54). When calculating Cronbach's α for the originally proposed factors based on individual items instead of subscales, the internal consistency findings were uniformly higher (Factor 1 = 0.85, Factor 2 = 0.81, Factor 3 = 0.70).

[TABLE 2 ABOUT HERE]

Psychometric properties of the ASSIST in the sample from Norway

Table 3 shows the factor structure for the Norwegian sample, with factor loadings sorted by size. The three extracted factors explained 57.9 % of the variance in the data. The structure was the same as with the whole sample and as suggested by theory, and with internal consistency estimates ranging between 0.64 (Factor 2) and 0.82 (Factor 3). When calculating Cronbach's α based on individual items instead of subscales, the internal consistency results were as follows: Factor 1 = 0.80, Factor 2 = 0.77, and Factor 3 = 0.70. The correlation matrix indicated that Factor 1 correlated -0.14 with Factor 2 and 0.34 with Factor 3, whereas Factor 2 correlated -0.16 with Factor 3.

[TABLE 3 ABOUT HERE]

Psychometric properties of the ASSIST in the sample from Hong Kong

Table 4 shows the factor structure for the Hong Kong sample, with factor loadings sorted by size. The three extracted factors explained 61.5 % of the variance in the data, with the third factor accounting for 8.7 % of the data variance. The structure was largely the same as with the total sample, apart from two exceptions: the *use of evidence* subscale and *interest in ideas* subscale, originally part of the *deep* approach, showed the strongest loadings onto Factor 1, together with the subscales belonging to the theoretically proposed *strategic* approach. The factors' internal consistency estimates, assessed by using the subscale scores, ranged between 0.63 (Factor 3) and 0.81 (Factor 1). The correlation matrix showed that Factor 1 correlated 0.07 with Factor 2 and 0.34 with Factor 3, whereas Factor 2 correlated 0.04 with Factor 3.

Given that the two deflecting subscales (*use of evidence* and *interest in ideas*) also loaded moderately (> 0.40) on Factor 3 (*deep* approach), as suggested by theory, the internal consistency using the originally proposed factor structure was re-assessed. This resulted in little change in the reliability estimates for Factor 1 (0.79) and Factor 2 (0.74), but increased

the estimate for Factor 3 (0.76). When calculating Cronbach's α based on individual items instead of subscales, the internal consistency results were the same or higher (Factor 1 = 0.85, Factor 2 = 0.84, and Factor 3 = 0.76).

[TABLE 4 ABOUT HERE]

Psychometric properties of the ASSIST in the sample from Singapore

Table 5 shows the factor structure for the Singapore sample, with factor loadings sorted by size. The three extracted factors explained 63.8 % of the data variance. The structure was the same as with the total sample, that is, all in accordance with the theoretical framework. The factors' reliability estimates, assessed by the subscale scores, ranged between 0.69 (Factor 2) and 0.81 (Factor 1). When calculating Cronbach's α based on individual items instead of subscales, the internal consistency results were higher for all three factors (Factor 1 = 0.85, Factor 2 = 0.81, Factor 3 = 0.81). The correlation matrix indicated that Factor 1 correlated -0.15 with Factor 2 and 0.34 with Factor 3, whereas Factor 2 correlated -0.10 with Factor 3.

[TABLE 5 ABOUT HERE]

Discussion

The initial assessment of internal consistency of the scales and subscales as theoretically established (Tait et al., 1998) revealed high estimates for the three scales. In general, Cronbach's α was above 0.80 for the *deep* and *strategic* approach scales, and above 0.70 for the *surface* approach scale. The subscales, however, exhibited lower and more variation in their levels of internal consistency. However, the same pattern has been shown in a range of studies concerned with the psychometric properties of the ASSIST (Ballantine et al., 2008;

Diseth, 2001; Reid et al., 2005; Reid et al., 2012; Richardson, 2010; Richardson et al., 2005; Valadas et al., 2010), and is generally not considered problematic. Scale assessment theory (e.g., Kline, 1994; Ponterotto & Ruckdeschel, 2007; Streiner & Norman, 2008) suggests that scales with fewer items will often display low internal consistency, while scales with more items will tend to have higher levels of internal consistency. This was also illustrated by the use of two alternative methods for obtaining internal consistency estimates for the main scales: estimates based on subscales were generally lower compared to estimates based on individual items.

The principal aim of this study was to confirm the established factor structure of the ASSIST in a cross-culturally composed sample of occupational therapy students. As denoted from Table 1, we were successful in accomplishing this aim. The three extracted factors explained 58.3 % of the total data variance, which is similar or just slightly lower than the results reported in previous research (e.g., Byrne et al., 2004; Diseth, 2001; Richardson, 2010; Richardson et al., 2005). The third factor explained 12.0 % of the data variance, and thus, the three-factor solution was supported also by assessing the amount of data variance explained by each additional factor.

All subscales loaded strongly on the expected factor. In view of Kline's (1994) classification of factor loadings, stating that loadings > 0.30 can be regarded as moderate, there were several instances of cross-loadings (i.e., subscales loaded > 0.30 on more than one factor). However, the subscales that cross-loaded did so (for the most part) on Factor 1 and Factor 3 – that is, on the *deep* and *strategic* approaches. This is in line with the theory underpinning the ASSIST (Entwistle et al., 2000; Tait et al., 1998), emphasizing that students who have a drive towards understanding will also tend to be *strategic* about how to achieve what they aim for. Conversely, *strategic* students will understand that assessments will often reward those who can demonstrate conceptual understanding. In addition, two subscales of

the *surface* approach (i.e., *lack of purpose* and *syllabus-bound*) cross-loaded negatively on the *strategic* and *deep* approach scales, respectively. The negative sign makes the cross-loadings understandable. A lack of purpose can be seen as the opposite of the *strategic* approach, as the *strategic* student has a very clear purpose – that is, to get the best grade possible. Similarly, restricting oneself to concentrate on the syllabus can be seen as clearly opposing the views and behaviours of the *deep* learner, who will often study beyond the syllabus in order to get a fuller understanding of the topic he or she works on.

The reported factor correlations, for the cross-cultural sample as well as for each of the country-specific sub-samples, also support an association between the *deep* and *strategic* approaches to studying, and no association or a negative association between the *surface* approach to studying and the two other approaches. The correlations between the factors denoting the *deep* and *strategic* approaches were all positive with a coefficient about, or slightly exceeding, 0.30. On the other hand, the factor denoting the *surface* approach to studying were unrelated to, or showed a weak negative association with, the two other factors. The same pattern of associations between the three different approaches to studying has been found in a range of previous studies (Byrne et al., 2004; Kreber, 2003; Richardson, 2005, 2010; Richardson et al., 2005; Valadas et al., 2010).

The second aim of the study was to examine if the factor structures obtained for each of the involved countries would mirror, or be dissimilar from, the factor structure shown for the total sample. For the Australian sample, the three factors explained 61.2 % of the variance in the data, and the third extracted factor explained 13.3 %. A three-factor structure was therefore deemed appropriate. Two subscales were divergent from the factor structure obtained for the total sample: the *lack of purpose* subscale loaded negatively and most strongly on Factor 1 (along with the *strategic* approach subscales), and the *syllabus-bound* subscale loaded negatively and most strongly on Factor 2 (along with the *deep* approach

subscales). In fact, this situation is similar to the one discussed for the cross-cultural sample. *Lack of purpose* can be viewed as directly opposed to a *strategic* approach; hence, the negative loading of this subscale on Factor 1 is explained. Similarly, *syllabus-bound* can be viewed as the opposite of a *deep* approach, as expressed by the negative loading of *syllabus-bound* on the *deep* approach scale. The cross-loadings shown in Table 2 can therefore be explained with reference to the same mechanisms as shown for the cross-cultural sample. Higher scores on the *lack of purpose* subscale appear to be more strongly related to decreasing the *strategic* approach score, than they are to increasing the *surface* approach score. Similarly, higher scores on the *syllabus-bound* subscale appear to be more strongly related to lower scores on the *deep* approach scale, than to higher scores on the *surface* approach scale.

For the sample from Norway, the three factors explained 57.9 % of the variance in the data, and the third extracted factor explained 11.0 % (Table 3). The three-factor structure was therefore appropriate. The factor structure was all in agreement with the theoretically proposed structure (Tait et al., 1998), with all subscales loading strongly on the expected factor. Cross-loadings were for the most part concurrent loadings on the *deep* and *strategic* approach factors. The *lack of purpose* subscale also negatively loaded on the *deep* approach scale. Therefore, it appears that the item content of the *lack of purpose* subscale is empirically opposed the *strategic* approach, as with the students from Australia, but also the *deep* approach, as with the students from Norway.

For the Hong Kong student group, the three factors explained 61.5 % of the variance in the data. However, the third extracted factor accounted for only 8.7 % of the variance (below the 10 % criterion), and the soundness of a three-factor structure is therefore questioned. If a three-factor structure is to be retained, one reasonable solution seems to be to use the structure as originally proposed. This implies that the *interest in ideas* and *use of*

evidence subscales would move from Factor 1 (*strategic* approach) to Factor 3 (*deep* approach), as can be seen on Table 4. The concurrent loadings on the *deep* approach would justify this proposition.

The other potential solution would be to use a two-factor structure. This solution implies that the *seeking meaning* and *relating ideas* subscales, currently loading most strongly on Factor 3 (*deep* approach), would move to Factor 1 (*strategic* approach). The cross-loadings of these subscales on Factor 1 can provide justification for doing this. The latter solution would in effect merge the *deep* and *strategic* approaches into one. From the available research literature, questions have been raised about the appropriateness of the three-factor structure. However, the issue has not been whether or not the number of factors should be reduced, but rather whether more factors should be extracted (Richardson et al., 2005). A more detailed analysis of the mechanisms underlying the results from Hong Kong appears warranted.

For the sample from Singapore, the three factors explained 63.8 % of the variance in the data, and the third extracted factor explained 12.6 % (Table 5). The three-factor structure was therefore appropriate, and as with the sample from Norway, the factor loadings were all in agreement with theory (Entwistle et al., 2000; Tait et al., 1998) and with the structure derived from the cross-cultural sample. Cross-loadings were mainly found between subscales loading on Factor 1 (*strategic* approach) and Factor 3 (*deep* approach). The *surface* approach *syllabus-bound* subscale cross-loaded negatively on Factor 1 (*strategic* approach), thus indicating that higher scores on this subscale tended to decrease the scores on the *strategic* approach scale.

Implications

The study implies that the ASSIST is sound to use with occupational therapy students in a variety of cultural settings. Overall, the established factor structure with three main scales is

valid when used with this group of undergraduate occupational therapy students. Considering other recent studies of occupational therapy students (Ashby, Adler, & Herbert, 2016; Brown et al., 2011; Richardson et al., 2005), the sample in the current study appears to be reflective of the characteristics of the population. However, the structure of the ASSIST may be influenced by the cultural context of where it is applied. Specifically, this study suggests that the ASSIST may generate a slightly different factor and sub-factor structure when used with students from Australia and Hong Kong, and alternative factor structures may need to be explored in more detail. When the ASSIST is used with students from Norway and Singapore, the instrument appears to function as expected from theory and previous research. In general, the main scales have good internal consistency, whereas the subscales demonstrate varying levels of internal consistency – often in the lower range – and should therefore be used with caution.

In the future, there appears to be particular need for longitudinal research that use the ASSIST to examine occupational therapy students' study approach development over time. Such research is gaining momentum in related healthcare fields (e.g., Mcdonald et al., 2017; Reid et al., 2012). Future research might also assess study approaches and their development in relationship to the students' personal characteristics (Bonsaksen, Sadeghi, & Thørrisen, 2017; Prat-Sala & Redford, 2010) as well as their perceptions of the learning environment, (Fryer & Ginns, 2017; Kreber, 2003; Sun & Richardson, 2016), both of which promising lines of inquiry.

Methodological considerations

Large samples generally yield more credible results than small ones, but there is no agreement as to what constitutes a sufficiently large sample (Pedhazur & Schemelkin, 1991). Some authors (e.g., Comrey, 1978) propose that samples consisting of more than 200 subjects may be characterized as large. Nunnally (1978), on the other hand, suggested that there

should be at least ten times as many subjects as variables, and this is generally accepted as the norm. Taking both of the above-suggested criteria into account, the total sample in this study was sufficiently large and well suited for factor analysis. The separate analyses conducted for the respective countries, however, were in some cases (in particular for the Hong Kong and Singapore subsamples) limited by a relatively small sample size, and should therefore be interpreted with caution. On the other hand, data for these subsamples did display satisfactory strength between the variables. Moreover, the KMO values and Bartlett's test of sphericity indicated that factor analysis was appropriate for all samples and subsamples.

The sample was one of convenience, and this may limit the generalizability of the study results. However, the main analysis in this study was one with a cross-cultural sample of participants recruited from four higher education institutions in four culturally diverse countries. In addition, the age composition and gender proportion of the cross-cultural sample seem to mirror the population, judging from other recent studies of occupational therapy students. All of the above strengthen the trustworthiness of the study results. In general, however, given the large proportion of participants from Australia (52.8 %), the results for the total sample were strongly influenced by this subset of the sample. The different age and gender distributions in the four country-specific samples may also have influenced the results.

Cronbach's α coefficient > 0.70 is usually considered good for scales consisting of fewer than seven items (Ponterotto & Ruckdeschel, 2007; Streiner & Norman, 2008). However, scales with few items may be unable to produce satisfactory α estimates, as was also the case with the subscales in this study. Previous studies have encountered similar low internal consistencies of the subscales (Valadas et al., 2010). The moderate to low internal consistency estimates for the subscales indicate that they should be used with caution. The main scales seem to have better validity and reliability. The different language versions of the

ASSIST used in this study may have had an impact on the results. The Norwegian student group completed the Norwegian translation of the ASSIST (Diseth 2001), whereas the student groups from Australia, Hong Kong, and Singapore completed the original English version (Tait et al. 1998). Finally, the study is limited in that it presents *how* the ASSIST functioned in the cross-cultural sample, and in each of the country-specific subsamples. Some differences were found between the four countries, but *why* these differences occurred may be an issue for future qualitative exploration.

Conclusion

The primary aim of the current study was to confirm the established factor structure of the ASSIST measure in a cross-cultural sample of occupational therapy students, and to examine whether the factor structure of the ASSIST's scales and subscales differed between the four country-specific subsamples. The main conclusion is that the established factor structure can be used cross-culturally; however, alternative structures may be explored – in particular when used with students from Hong Kong. In addition, the secondary aim was to establish measures of internal consistency related to each of the scales and subscales. The results indicated that the main scales, representing the *deep*, *strategic*, and *surface* approaches to studying, all had high levels of internal consistency. With regard to the thirteen subscales, internal consistency estimates varied much and were often in the lower range.

Key points for occupational therapy

- The ASSIST measures students' deep, strategic, and surface study behaviours
- The main scales of the ASSIST is sound to use with occupational therapy students cross-culturally
- Within country-specific samples, the factor structure of the ASSIST may deviate slightly from the main pattern

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Table 1. *Factor structure of the ASSIST in the cross-cultural sample: factor loadings, communalities, Eigenvalue estimates (λ), reliability estimates (Cronbach's α), and variance explained by the factors (n = 712)*

ASSIST Subscales	Factor 1	Factor 2	Factor 3	Communalities
Time management	**0.87**	-0.13	0.34	0.76
Organized study	**0.86**	-0.06	0.29	0.73
Achieving	**0.78**	-0.17	0.41	0.65
Monitoring effectiveness	**0.58**	-0.15	0.49	0.45
Alertness to assessment demands	**0.51**	0.11	0.04	0.29
Unrelated memorizing	0.04	**0.77**	-0.10	0.60
Fear of failure	0.09	**0.70**	0.17	0.57
Lack of purpose	-0.35	**0.66**	-0.15	0.54
Syllabus-bound	-0.05	**0.59**	-0.40	0.46
Relating ideas	0.15	-0.10	**0.84**	0.72
Use of evidence	0.24	-0.06	**0.83**	0.69
Interest in ideas	0.36	-0.13	**0.68**	0.48
Seeking meaning	0.33	-0.02	**0.64**	0.44
λ	32.3	16.5	12.6	
Cronbach's α	0.80	0.62	0.77	
Explained variance	30.7 %	15.6 %	12.0 %	
Total explained variance		58.3 %		

Note. Results derived from Principal Component Analysis with a forced 3-factor solution, using Direct Oblimin rotation with Kaiser Normalization. Factor loadings are taken from the structure matrix. ASSIST: *Approaches and Study Skills Inventory for Students.*

Table 2. *Factor structure of the ASSIST in the Australian sample: factor loadings, communalities, Eigenvalue estimates (λ), reliability estimates (Cronbach's α), and variance explained by the factors (n = 376)*

ASSIST Subscales	Factor 1	Factor 2	Factor 3	Communalities
Organized study	**0.87**	0.26	0.09	0.76
Time management	**0.84**	0.35	0.01	0.72
Achieving	**0.81**	0.40	-0.05	0.69
Monitoring effectiveness	**0.60**	0.49	-0.01	0.48
Lack of purpose	**-0.58**	-0.25	0.42	0.52
Alertness to assessment demands	**0.48**	-0.11	0.09	0.30
Relating ideas	0.13	**0.88**	-0.04	0.78
Use of evidence	0.26	**0.85**	-0.01	0.74
Interest in ideas	0.33	**0.62**	-0.07	0.41
Seeking meaning	0.42	**0.57**	0.09	0.43
Syllabus-bound	-0.04	**-0.56**	0.48	0.51
Fear of failure	0.09	0.21	**0.80**	0.71
Unrelated memorizing	0.00	-0.18	**0.79**	0.63
λ	35.8	14.8	14.0	
Cronbach's α	0.53	0.54	0.62	
Explained variance	33.9 %	14.0%	13.3 %	
Total explained variance		61.2 %		

Note. Results derived from Principal Component Analysis with a forced 3-factor solution, using Direct Oblimin rotation with Kaiser Normalization. Factor loadings are taken from the structure matrix. ASSIST: *Approaches and Study Skills Inventory for Students.*

Table 3. *Factor structure of the ASSIST in the Norwegian sample: factor loadings, communalities, Eigenvalue estimates (λ), reliability estimates (Cronbach's α), and variance explained by the factors (n = 160)*

ASSIST Subscales	Factor 1	Factor 2	Factor 3	Communalities
Interest in ideas	**0.84**	-0.26	0.25	0.73
Relating ideas	**0.75**	-0.08	0.24	0.57
Seeking meaning	**0.66**	-0.03	0.39	0.47
Use of evidence	**0.64**	0.03	0.38	0.45
Fear of failure	0.17	**0.82**	-0.04	0.78
Unrelated memorizing	-0.19	**0.80**	0.02	0.64
Lack of purpose	-0.42	**0.57**	0.03	0.47
Syllabus-bound	-0.14	**0.56**	-0.12	0.32
Time management	0.30	-0.13	**0.84**	0.72
Organized study	0.30	-0.13	**0.82**	0.68
Achieving	0.47	-0.26	**0.74**	0.64
Alertness to assessment demands	0.17	0.23	**0.59**	0.41
Monitoring effectiveness	0.50	-0.06	**0.53**	0.39
λ	30.0	20.0	11.8	
Cronbach's α	0.77	0.64	0.82	
Explained variance	28.1 %	18.8 %	11.0 %	
Total explained variance		57.9 %		

Note. Results derived from Principal Component Analysis with a forced 3-factor solution, using Direct Oblimin rotation with Kaiser Normalization. Factor loadings are taken from the structure matrix. ASSIST: *Approaches and Study Skills Inventory for Students.*

Table 4. *Factor structure of the ASSIST in the Hong Kong sample: factor loadings, communalities, Eigenvalue estimates (λ), reliability estimates (Cronbach's α), and variance explained by the factors (n = 109)*

ASSIST Subscales	Factor 1	Factor 2	Factor 3	Communalities
Time management	**0.90**	-0.08	0.24	0.84
Organized study	**0.76**	-0.03	0.18	0.58
Achieving	**0.74**	0.08	0.25	0.54
Monitoring effectiveness	**0.62**	-0.04	0.24	0.39
Interest in ideas	**0.62**	0.22	0.46	0.48
Alertness to assessment demands	**0.56**	0.23	0.30	0.37
Use of evidence	**0.52**	0.03	0.48	0.38
Lack of purpose	0.05	**0.81**	0.43	0.83
Unrelated memorizing	0.11	**0.74**	0.05	0.55
Fear of failure	0.08	**0.71**	-0.48	0.82
Syllabus-bound	-0.12	**0.69**	-0.08	0.51
Seeking meaning	0.51	0.04	**0.66**	0.53
Relating ideas	0.42	0.11	**0.65**	0.47
λ	26.0	20.4	7.6	
Cronbach's α	0.81	0.74	0.63	
Explained variance	29.7 %	23.2 %	8.7 %	
Total explained variance		61.5 %		

Note. Results derived from Principal Component Analysis with a forced 3-factor solution, using Direct Oblimin rotation with Kaiser Normalization. Factor loadings are taken from the structure matrix. ASSIST: *Approaches and Study Skills Inventory for Students.*

Table 5. *Factor structure of the ASSIST in the Singapore sample: factor loadings, communalities, Eigenvalue estimates (λ), reliability estimates (Cronbach's α), and variance explained by the factors (n = 67)*

ASSIST Subscales	Factor 1	Factor 2	Factor 3	Communalities
Time management	**0.91**	-0.29	0.16	0.88
Organized study	**0.86**	-0.09	0.44	0.76
Achieving	**0.82**	-0.14	0.37	0.68
Monitoring effectiveness	**0.59**	-0.32	0.43	0.45
Alertness to assessment demands	**0.39**	0.05	0.28	0.19
Lack of purpose	0.10	**0.81**	-0.32	0.83
Syllabus-bound	-0.46	**0.69**	-0.19	0.61
Fear of failure	-0.15	**0.69**	0.07	0.50
Unrelated memorizing	-0.12	**0.65**	-0.06	0.42
Interest in ideas	0.43	0.02	**0.83**	0.72
Seeking meaning	0.38	-0.28	**0.76**	0.63
Relating ideas	0.31	-0.05	**0.74**	0.55
Use of evidence	0.20	-0.07	**0.71**	0.51
λ	33.7	18.2	12.8	
Cronbach's α	0.81	0.69	0.79	
Explained variance	33.2 %	18.0 %	12.6 %	
Total explained variance		63.8 %		

Note. Results derived from Principal Component Analysis with a forced 3-factor solution, using Direct Oblimin rotation with Kaiser Normalization. Factor loadings are taken from the structure matrix. ASSIST: *Approaches and Study Skills Inventory for Students.*