VALIDITY AND RELIABILITY OF TWO INSTRUMENTS TO MEASURE REFLECTION: A CONFIRMATORY STUDY

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Abstract. Over the years, researchers have used several methods to investigate reflection. These are based on various theories. Researchers mainly use qualitative methods to study reflection, but mixed methods and quantitative studies are carried out as well. A number of different scales have been developed and used to measure reflection. The main purpose of this paper is to explore the internal consistency and factor structure of two instruments for measuring reflection to find out the validity and reliability of such assessment instruments. Data was collected using two questionnaires to estimate reflection at the start of the teaching practice and induction year. The results indicated that both instruments of reflection demonstrated the validation and reliability of measure reflection. The study also showed that these scales are suitable to use in different disciplines in teacher education.

Keywords: teacher reflection, reflection instrument, teaching practice, induction year teachers, confirmatory factor analysis, measure reflection

1. Introduction

It is generally acknowledged that reflective teaching and reflective practices play an important role in teacher education. Reflection is also an important part in teachers' professional behaviour and relevant in their professional development. Various authors have pointed out the usefulness and necessity of reflection. For example, Killeavy and Moloney (2010) highlighted the ability to reflect on practice as the basis for learning. In addition, personal experiences are important in the teachers' development today, and reflection is one method that supports such development (Shoffner 2009); the ability to reflect evolves out of our experiences both as a professional and a person (Scanlan and Chernomas 1997). In many countries teacher education programmes operate with the notion that reflec-

tion is a critically important characteristic of an effective teacher. In Estonia, the ability to reflect on teaching practice is also one of the standards for teaching.

Although reflection is key to the development of a professional teacher, several authors have indicated that it is not well defined and this can cause problems in understanding the meaning of reflection (e.g. Kreber 2005, Maaranen and Krokfors 2007). Reflection, however, can be used more deliberately if we realize its meaning and impact on our personal and professional development (Scanlan and Chernomas 1997). In this paper, we initially examine the definition of and theories about reflection because it is important to know how the process of reflection works in practice. Secondly, we conducted an overview of certain instruments used to measure reflection and examined their validity and reliability.

The starting point for defining reflection is usually problematic (Akbari et al. 2010), but historically, Dewey is acknowledged as one of the originators of the concept of reflection in the twentieth century (Hatton and Smith 1995). In most articles dealing with reflective teaching, the roots of the term are traced back to John Dewey (1933). According to Dewey (1933:9), reflection is "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it". Furthermore, reflection needs communication to formulate experience (Dewey 1930). Scanlan and Chernomas (1997) assert that reflection is a mental process that we all use in our everyday lives. However, reflection can be further developed for specific professional purposes. If we can become more aware of what reflection entails then we should be able to label more accurately the mental processes of reflection and further develop other reflective skills for professional purposes. Gibbs (1988) argued that without reflecting, received experience may be forgotten or the learning potential lost. His model of reflection contains six stages: description, feelings, evaluation, analysis, conclusion and action plan. Mezirow (1991: 104) claimed that "reflection is the process of critically assessing the content, process, or premise(s) of our efforts to interpret and give meaning to an experience". It includes thoughtful action with reflection or premise reflection. Premise reflection leads to critical reflection – this means more fully developed perspectives on meaning. Reflective learning can be divided into confirmative or transformative learning. Transformative learning produces new or transformed meaning while reflection focuses on premises. Therefore, reflection does not only involve a simple awareness of our experiences. Non-reflective action may be habitual action that takes place outside of focal awareness or thoughtful action with higher cognitive processes (Mezirow 1991).

Discussing the topic of reflection may be based on other well-known theories. For example, the five-factor personality theory describes five basic personality factors (extroversion, agreeableness, conscientiousness, emotional stability, and intellect/autonomy) (Hendriks et al. 1999). Aukles et al. (2007) applied this theory to develop a scale of reflection. Sobral (2001) used the concept of reflection as a cognitive regulation strategy. It is essential for information processing, particularly selective attention, decoding, rehearsal, elaboration and organization. Students

who use self-regulation and are metacognitively aware of what they are doing (include orientation, planning, execution, monitoring, reflection, and self-testing) can better apply different skills (Boekaerts 1997). One more possible related theory is constructivism – the learning or meaning-making theory where people composes their own new understandings. This is based on the interaction between prior and new knowledge that is useful for deep understanding. In addition, social constructivism, including constructed knowledge, is where a person interacts with the environment and changes this learning process (Richardson 1997).

As mentioned above, reflection is not well defined and there is a lack of consensus about what reflection actually entails. Therefore, some authors have developed their own model of reflection to design an instrument. For instance Akbari et al. (2010) promoted their tentative model of teacher reflection, underlying related literature and expert opinions. Their five-factor model contains practical, cognitive, affective, meta-cognitive, and critical components of reflection. Another example is the generic model of self-regulation and goal attainment. To commence purposeful progress through the cycle of self-regulation, the individual can monitor and evaluate their own progress and use feedback to correct their performance (Grant et al. 2002).

Altogether, some researchers of reflection focused on personal characteristics (Aukles et al. 2007), while others describe the actions (Sobral 2001, Grant et al. 2002), and the third point out that new and deeper understanding based on interaction between prior and new knowledge (Richardson 1997). Thus, the researches approached the reflection on the definition and theory very differently, which represents another topic of reflection. Knowledge of various definitions and theories of reflection enables us to better understand why we have not been able to deal with reflection unambiguously. In addition, researchers can compare the theories, next find a suitable one for their own situation, and then use it effectively in promotion of reflection. Besides, all this knowledge helps the authors of this research paper to better accomplish the goals of this article.

1.1. Methods and instruments of reflection in earlier studies

The goals of earlier studies of reflection have varied. Some authors have wanted to develop a scale of reflection (e.g. Aukes et al. 2007), some have explored what methods and aspects of reflection have been used (e.g. Ottesen 2007) and others have found the relationships between the environment and reflection (Sobral 2001) and explored how the several internet tools (e.g. blogs, portfolios, web-logs) support reflective learning (e.g. Yang 2009). Despite the different purposes of studies, they have had the common aim of providing information about reflection and its assessment.

Over the years, researchers have used several approaches and methods to measure reflection. Quantitative (e.g. Sobral 2001), qualitative (e.g. Maaranen and Krokfors 2007) and mixed (e.g. Killeavy and Moloney 2010) methods have been used. Qualitative studies have included interviews (e.g. Luttenberg and Bergen 2008), essays (e.g. Maaranen and Krokfors 2007), audio taped discussions and

ethnographic field notes (Ottesen 2007) and the posting of messages and comments in blogs (e.g. Shoffner 2009) and portfolios (e.g. Tigelaar et al. 2006). The methodologies, however, were based on different theories and approaches than those mentioned above. For example, the interviews were conducted using a conventional constructivist theory (Luttenberg and Bergen 2008), Mezirow's transformative learning theory (Krebel 2005) and Hatten and Smith's operational framework (Alger 2006). Moreover, to measure reflection using essays, the research took an analytical and holistic approach, in addition to including Dewey's and Schön's analyses of the steps of reflection (Maaranen and Krokfors 2007). The audiotaped discussions built on sociocultural theory (Ottesen 2007) and the assignments in the portfolio were based on Kortagens' aspects of the model of teacher functioning (Tigelaar et al. 2006). The qualitative analysis of blog posts followed a modified version of the Moustakas method, Mezirow's descriptions of reflectivity (Chretien et al. 2008) and Ho and Richard's framework (Yang 2009).

In the quantitative studies (also mixed method studies), different scales have been applied to estimate reflection (See Table 1). These measurements have been constructed and built on several of the theories and approaches described above.

Table 1. The instruments to measure reflection

Instrument	Reference	Basis	Description	Reliability (Cronbach`s alpha)
Groningen Reflection Ability Scale	Aukes et al. 2007	– Earlier literature – Five Factor personality theory – Educational practice	One-dimensional scale with three relevant aspects of that dimension: Self-reflection, empathetic reflection and reflective communication. Contains 23 items on a 5-point Likert scale.	0.83 (1st measurement) 0.74 (2nd measurement).
Reflection in Learning Scale	Sobral 2001	– Multiple sources of information as reported before. – Cognitive regulation strategy	Contains 14 items composed of 7 to 18 words and 7-point response scale (never = 1 and always = 7). In addition to the 14 items, the instrument includes a 4-point global scale with a view to assessing personal efficacy for reflection on learning (ranging from restricted to maximal).	0.84 (at the start) and 0.86 (at the end of term).
Self-Reflection and Insight Scale	Grant, Franklin and Langford 2002	– Generic model of self-regulation and goal attainment	20 statements on a 6-point scale (ranging from strongly disagree to strongly agree). Contains 2 scales: self-reflection and insight scale.	0.77 (Self-Reflection Scale) 0.78 (Insight Scale)
Reflection Questionnaire	Kember et al. 2000	Mezirow framework	16 items on a 5-point scale (Definitely agree to Definitely disagree). Contains 4 scales: habitual action, understanding, reflection, critical reflection.	0.62–0.76

Instrument	Reference	Basis	Description	Reliability (Cronbach`s alpha)
The reflective teaching instrument	Akbari, Behzadpoor, and Dadvand 2010	– Tentative model of teacher reflection based on related literature and experts' opinion.	29 items on a 5-point scale (Never to Always). Contains 5 scales: practical, cognitive, affective, meta-cognitive and critical.	0.73–0.84
Teacher Reflection Scale (Kayapınar and Erkus 2009)	Armutcu and Yaman 2010	– Social constructivist model	22 items	0.84

The main purposes of this paper are to identify the internal consistency to test the reliability and to explore the factor structure, and to verify the validity of two instruments for measuring reflection: the Reflection Questionnaire (Kember et al. 2000) and the Reflection in Learning Scale (Sobral 2001).

2. Method

2.1. Participants

The total sample was 216 respondents (206 women, 10 men), including 127 student teachers and 89 induction year teachers from two universities in Estonia. The average age of the student teachers was 23.08 (SD = 3.60) and of induction year teachers 27.84 (SD = 6.94). Among the respondents were 87 pre-school teachers (40%), 41 primary school teachers (19%), 50 basic and secondary school teachers of humanities (23%), 26 teachers of science and mathematics (12%), and 7 of the respondents were teachers of art, crafts and physical education (3%). The remaining respondents (speech therapists, special education teachers etc.) totalled 5 (3%). All induction year teachers participating in the cluster sampling (different curricula were represented) who started this year were used to sample student teachers from Tartu University and Tallinn University in the 2010/11 academic year. The cluster sampling was used, because instruments adapted to examine the student teachers' from different curricula and induction year teachers' reflection.

2.2. Instruments

The entire questionnaire consisted of eight sub-scales including 119 items, which explored different aspects of being a teacher. Furthermore, background data was also included. The sub-scales used to estimate reflection were: The

Reflection Questionnaire (Kember et al. 2000) and the Reflection in Learning Scale (Sobral 2001).

2.2.1.Reflection Questionnaire

The original Reflection Questionnaire (Kember et al. 2000) contains 16 items for the respondents to engage in reflective thinking and its extent. This version of the questionnaire includes four scales and each is measured using four items. The scales are: habitual action, understanding, reflection and critical reflection. These item features are on a 5-point response scale (1 = definitely disagree; 5 = definitely agree). In this study the last two scales were used to measure reflection. The items were translated into Estonian and the comprehension of each was then discussed within the research team. After a pilot study some items were reworded for better clarity.

2.2.2. Reflection in Learning Scale

The Reflection in Learning Scale (Sobral 2001) is a self-report questionnaire to evaluate reflection in learning. The instrument comprises 14 items, and in addition, includes a four-point global scale for assessing the personal efficacy of the reflection on learning. The extent of perceived personal efficacy ranged from restricted to maximal. The main scale was measured using a 7-point scale (1 = never; 7 = always) assessing the degree to which the respondents use reflection in learning. In this study, a 5-point response scale was used to maximise consistency with other scales. All the items were translated into Estonian and their suitability for the Estonian context was discussed. After a pilot study, some items were reworded for better clarity and one item was left out (10. Systematically, I reflected about how I was studying and learning in different contexts and circumstances) because the translation of that item was not distinguishable from others.

2.3. Procedure

The questionnaires were administered at the start of the teaching practice and induction year. Practice and induction year coordinators were asked for permission to carry out the study. The questionnaires were given or sent to the respondents and completed during the seminar, on paper, or electronically on a computer. The response rate to the survey was 100%.

The data was then analysed using the LISREL 8.8 software, because it enables to apply confirmatory factor analyses if data is on ordinal scale. The scales were subjected to factor analyses to examine the psychometric properties of the two scales of reflection. Confirmatory factor analyses were conducted (CFA), including estimates of weighted least squares with various fit indices. The statistical indices used to evaluate the structural models for different countries (Step 1) were as follows: root mean square error of approximation (RMSEA; Browne and Cudeck 1993), and the comparative fit index (CFI; Bentler 1990). The following

criteria were adopted to produce adequate model fit: *CFI* and *GFI* ≥ .95 (Brown 2006; Hu and Bentler 1999). *CFI* is independent of sample sizes. *RMSEA* has certain specifications. *RMSEA* values less than 0.05 suggest good model fit, while models with *RMSEA* ≥ 0.1 should be rejected. *RMSEA* ≤ 0.08 suggest adequate model fit (Browne and Cudeck 1993). In addition, reliability analyses were used to measure the internal consistency (Cronbach's alpha) of the sub-scales.

3. Results

Kember's shortened Reflection Questionnaire two-factor model (reflection and critical reflection) was evaluated through a confirmatory factor analysis (CFA) using a generalized least squares estimation. The Goodness of Fit statistics for this model did not indicate adequate model fit. The chi-square statistic for the measurement model normalized by degrees of freedom (χ^2/df) did not exceed 3.0 as is suggested ($\chi^2 = 55.58$, df = 19, $\chi^2/df = 2.9$) and GFI was 0.98, which is also within the acceptable criteria range, but the RMSEA was 0.095, which exceeded the criteria 0.08 (Brown 2006). The factor loadings and residuals of the model are shown in Table 2.

Table 2. Confirmatory factor analysis of first tested model of Reflection Questionnaire

Item	Loading	Residue
Reflection (R)		
1. I sometimes question the way others do something and try to think of a better way (R1)	.45	.80
2. I like to think over what I have been doing and consider alternative ways of doing it (R2)	.76	.43
3. I often reflect on my actions to see whether I could have improved on what I did (R3)	.95	.09
4. I often re-appraise my experience so I can learn from it and improve for my next performance (R4)	.85	.27
Critical reflection (CR)		
5. As a result of this course I have changed the way I look at myself (CR1)	.65	.58
6. This course has challenged some of my firmly held ideas (CR2)	.66	.56
7. As a result of this course I have changed my normal way of doing things (CR3)	.85	.27
8. During this course I discovered faults in what I had previously believed to be right (CR4)	.70	.51

An examination of the standardized factor loadings and modification indices showed that the fifth item ("As a result of this course I have changed the way I look at myself") could belong in both factors. The CFA was re-examined and the acceptable final model is presented in Figure 1.
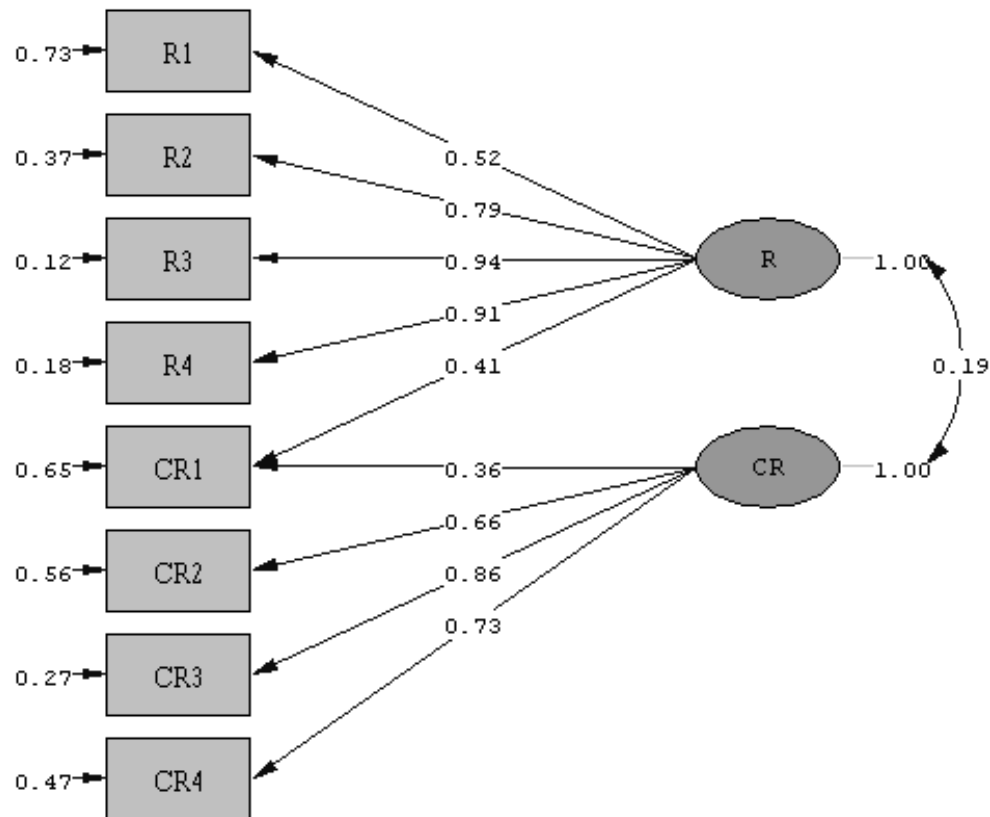
Figure 1. Model of Reflection Questionnaire.

The Goodness of Fit statistics for this model showed adequate fit between the hypothesised model and observed data: $\chi^2 = 29.66$, df = 18 (χ^2/df =1.64), RMSEA = .055 and GFI = .99. The diagnostic measures indicated that no substantial improvement could be made to the model. Despite standardized residuals three items (R1, CR1, and CR2) above 0.5, and the standardized factor loading of CR1 being lower than the other standardized factor loadings, eliminating these items did not make any improvement to the model. Thus, the CFA result validated the two-factor structure of Kember's scale indicating reflection (Factor 1) and critical reflection (Factor 2).

The convergent validity of the two-factor scale model was then evaluated. Factor loadings were high for all the shortened Reflection Questionnaire items and significant at a level of 0.05. The reliability of both factors was acceptable (Cronbach alphas accordingly 0.77 and 0.70). The discriminant validity of the model was assessed through correlation between the factors. The two factors were weakly related to each other (0.19). This implied that the two factors exhibit convergent and discriminant validity of the shortened Reflection Questionnaire.

To verify the one-factor structure of the Reflection in Learning Scale identified by Sobral (2005), a CFA using a generalized least squares estimation was performed. The Goodness of Fit statistics of this model did not indicate an adequate model fit. Again the chi-square statistic for measurement model normalized according to degrees of freedom (χ^2/df) and the GFI were adequate (χ^2 = 177.24, df = 65, χ^2/df = 2.7, GFI = .96), but the RMSEA was not within the acceptable criteria range (RMSEA = 0.090, factor loadings and residuals of the model are shown in Table 3). Therefore, the data was put through an exploratory factor analysis (EFA) to investigate the dimensionality of the translated Reflection in Learning Scale. A principal components factor analysis with varimax rotation was used. The EFA showed a four-factor structure with all factor loadings over 0.40. The factor solution extracted 62.6% of the variance and consisted of factors such as planning, monitoring, reflection and self-testing. To verify the factor structure identified through the EFA, the CFA was re-performed. After checking the standardized residuals and factor loadings of the model, three items were removed for further analysis (items 3, 11 and 12) because of the high standardized residuals and low standardized factor loadings. All the Goodness of Fit statistics used (χ^2/df, RMSEA and GFI) fell within the established criteria (χ^2 = 57.35, df = 29, χ^2/df = 1.98, RMSEA = .067, GFI = .98). The standardized factor loadings and residuals of the model are shown in Table 3.

The strong positive correlations between factors (0.56 – 0.86) predicted a second-order factor. A second-order CFA was conducted on the remaining 10 items to evaluate the purposed second-order structure of the Reflection in Learning Scale (see Figure 2).

The second-order factor structure also demonstrated an adequate fit (χ^2 = 58.54, df = 31, χ^2/df = 1.89, RMSEA = 0.064, GFI = 0.98). Since the Goodness of Fit statistics of the first and second-order models were almost identical, the second-order model was accepted because it is more parsimonious and better fits with the one-factor structure of the Reflection in Learning Scale identified by Sobral (2005). Nevertheless, the standardized residual of the last item (ST13) was over 0.5 and the standardized factor loading of the planning factor as a first-order factor was lower than the factor loadings of the other first-order factors.

The convergent validity of the one-factor scale model was evaluated. Factor loadings of the first-order factors on the second-order factor of the Reflection in Learning Scale were high and significant at an alpha level of 0.05. The reliability of the Reflection in Learning Scale was acceptable (Cronbach's alpha 0.84). The discriminant validity of the model was assessed through correlation among the factors of Kember's shortened Reflection Questionnaire factors. The correlation coefficient with Kember's reflection factor was 0.50 and with Kember's critical reflection 0.20.

Table 3. Confirmatory factor analysis with one-factor model and four-factor model solutions of Reflection in Learning Scale

Item Reflection in learning (RINL)	1-factor solution		4-factor solution							
			Planning (P)		Monitoring (M)		Reflection (R)		Self-testing (ST)	
	L*	R*	L	R	L	R	L	R	L	R
1. Carefully planned my learning tasks in the courses and training activities (P1)	.66	.57	.74	.45						
2. Talked with my colleagues about learning and methods of study (P2)	.66	.57	.76	.43						
3. Reviewed previously studied subjects during each term	.58	.66			-	-				
4. Integrated all topics in a course with each other and with those of other courses and training activities (M4)	.88	.23			.81	.34				
5. Mentally processed what I already knew and what I needed to know about the topics or procedures (M5)	.82	.33			.80	.37				
6. Been aware of what I was learning and for what purposes (R6)	.87	.24					.85	.28		
7. Sought out interrelations between topics in order to construct more comprehensive notions about some theme (R7)	.88	.22					.91	.17		
8. Pondered over the meaning of the things I was studying and learning in relation to my personal experience (R8)	.84	.29					.84	.29		
9. Conscientiously sought to adapt myself to the varied demands of the different courses and training activities (ST9)	.83	.31							.87	.24
10. Mindfully summarised what I was learning day in, day out, in my studies (ST10)	.81	.34							.75	.44
11. Exerted my capacity to reflect during a learning experience	.73	.47							-	-
12. Diligently removed negative feelings in relation to aims, objects, behaviours, topics or problems	.64	.59							-	-
13. Constructively self-assessed my work as a learner (ST13)	.76	.42							.63	.60

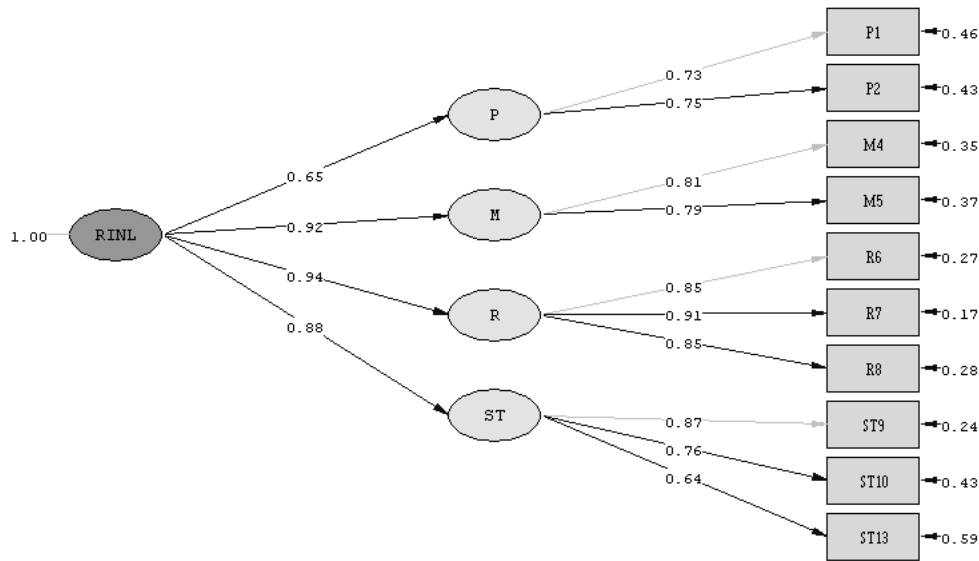* L – factor loading, R - residue

Figure 2. Structural model of Reflection in Learning Scale

4. Conclusions

The main purpose of this paper was to investigate the validity and reliability of two reflection measurements using confirmatory factor analysis. The results confirmed the two-factor structure of the Reflection Questionnaire. This model consists of two factors: reflection and critical reflection as reported before (Kember et al. 2000; Leung and Kember 2003). In this study one item ("As a result of this course I have changed the way I look at myself") was in both reflection and critical reflection factors. The earlier analysis indicated that four items of each scale were not included in the other factor (Kember et al. 2000; Leung and Kember 2003*)*. Furthermore, the factor loading for the mentioned item was low in both factors. The reliability of both scales was moderate and quite equal to the results of earlier studies (Kember et al. 2000; Leung and Kember 2003). The moderate reliability of the factors may be caused by the low number of items in each sub-scale because both sub-scales include only four or five items. Kember (2003) also reached to the same conclusion. Kember's reflection scale describes 12.25% of Kember's critical reflection scale. So, the factors of the Reflection Questionnaire are thus weakly related to each other but measure different aspects. This result confirmed the discriminate validity of the Reflection Questionnaire.

The validity of the second model, the Reflection in Learning Scale, was also tested in the current study. The results of this shortened 10-item scale indicated one second-order factor model including four first-order factors. The second-order

factor was labelled as reflection in learning, and the four first-order factors were planning, monitoring, reflection and self-testing. These factors are named by the authors of this article, according to the theory of cognitive regulation strategy (Boekaerts 1997). Comparing the results of this study with earlier findings, the two-factor (10-item version) (Sobral 2000) and three-factor structure (14-item version) (Sobral 2005) was identified. This two-dimensional scale was divided into integration and monitoring of the learning sub-scale (Sobral 2000), and although the three-factor structure was also revealed, the first factor was dominant with higher loadings than subsequent factors (Sobral 2005). Compared to Sobral's (2000, 2001, 2005) studies, the exploratory factor analysis is used in there, so his results might differ from our research. Also, Sobral (2005) mentioned that the Reflection in Learning Scale may be acceptable as a unidimensionality instrument as the results of this study showed. The reliability analysis of the Reflection in Learning Scale showed good internal consistency as in previous studies (Sobral 2000, Sobral 2001, Sobral 2005).

The test of the discriminate validity of the three reflection scales showed that the Reflection in Learning Scale describes 25% of Kember's reflection scale and 4% of Kember's critical reflection scale. The three tested scales thus measure different aspects of reflection. The results of this study showed that the Reflection Questionnaire and the Reflection in Learning Scale are suitable for use in the field of education. These scales also demonstrated their suitability for testing reflection in student teachers and induction year teachers. The authors of the questionnaires applied them to undergraduate and postgraduate students (Kember et al. 2000; Leung and Kember 2003) at the start and the end of the third semester (Sobral 2001, 2005) in different disciplines in the health sciences. Based on the results of this study and earlier research (Kember et al. 2000), we recognize that the Reflection Questionnaire and the Reflection in Learning Scale should also be suitable for other disciplines.

In this study, only the results from student teachers and induction year teachers were used. Kember et al. (2000), Leung and Kember (2003) also tested postgraduate students, who were more experienced than student teachers and induction year teachers. Thus, the Reflection Questionnaire may be appropriate to test student teachers and induction year teachers after their practice and induction year. In addition, the authors of this instrument pointed out the opportunity to use the Reflection Questionnaire as a repeated measurement to identify the results of reflection (Kember et al. 2000).

There are some limitations of this study and suggestions for future work. First, in order to make exact comparisons with other findings, all the items from the original scale should be represented. In this study one item was left out, and therefore, full comparisons of the scales are not possible. Second, the sample consists of induction year teachers and student teachers. If these groups were tested separately, the results may be different.

It is normal for questionnaires to require a development process and several tests to prove the suitability of the measurement. In this study, two reflection

scales were translated and adapted to the Estonian context. Despite these limitations, we suggest that this study demonstrated the validity and reliability of two instruments for measuring reflection. In addition, the present study showed that these scales are suitable for use in different disciplines in teacher education. To measure the practice of reflection in teachers, reliable tools first need to be developed to see the current state of reflection, and only then can we know what can be used in teacher education in the future.

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