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Validation procedure MILQ

Research report validation procedure

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1. Introduction

The literature study is conducted by order of CLU, Center for Textbook Studies (in association with Utrecht University). CLU is involved in investigating the quality of learning materials, designing educational programs and developing training for teachers. For twenty-five years CLU cooperates with organizations aiming at improvement of educational quality. Moreover, governments, education in general and businesses, both national and international are within the field of interest. Furthermore, educational developments are closely followed and criticized on their effectiveness. In particular the instrument used to assess the effectiveness of learning materials called Measurement Instrument Learning materials Quality (MILQ), is a valuable product designed by CLU.

2. Problem definition

In science, many measurement instruments are developed. Although most of them have a scientific basis, standardized procedures about how validation is done appropriately are not available (Akkerman, et al., 2008). In addition, guidelines about optimal numbers of content experts, selection and training of the experts, and the collection and analysis of content-related evidence have only been proposed by a few researchers (Goodwin & Leech, 2003). Moreover, studies that are enrolled in the development of manageable units of analysis and categories such as in developing an instrument are susceptible for subjectivity and interpretation. Consequently, the trustworthiness of the findings is undermined which is in contrast to studies with standardized methods (Akkerman, et al., 2008). However, Akkerman and colleagues (2008) report that few literature is found on appropriate validation processes within the literature databases for social sciences. Therefore, it appears to be of great value to develop an appropriate validation procedure of the MILQ.

The MILQ consists of nine parts each representing a specific learning function of learning material. Currently seven of the nine parts of the MILQ are validated. For each part scientific evidence has been found and formed the foundation for revising the items and subjects. The seven parts are: *Selecting content, Choice of modalities, Choice of learner activities, Choice of didactical strategies, Readability of texts, Functionality of illustrations, Design and Lay-out.* Nevertheless, the other parts of the MILQ still need to be validated. Consequently, CLU requests a standardized procedure when validating the MILQ in order to ensure a well-founded and valid measurement instrument.

This validation report entails a literature study which forms the basis of the recommended validation procedures. On the one hand, alignment is made between items of the MILQ and recent studies, and on the other hand it is investigated how the items of the MILQ can stay up-to-date. Therefore, the research questions are as follows: *What*

validation procedure is best suitable when validating the MILQ? And how can the validation of the instrument stay up-to-date?

In the remainder of this report a theoretical framework is presented, which combines, integrates and discusses research in the field of validation. This theoretical framework will result in a procedure which is best suitable for validating the MILQ and specific procedures are advised to keep the MILQ up-to-date. Based on the findings conclusions are drawn and research questions are answered.

3. Theoretical framework

In this section attention is paid to the MILQ and its underlying dimensions and to more general theories about validation.

3.1 MILQ

Before literature about validation is discussed, it is important to provide insight in the instrument of interest: MILQ. The MILQ has 157 items and distinguishes three dimensions with each three learning functions (Reints & Wilkens, 2012), as summarized in Table 1.

Table 1.

Dimensions and Learning Functions of MILQ with their Underlying Concepts

Dimensions	Learning functions	Concepts
Quality of the content	Selection of the content is in alignment with the target group/learning objectives	Prior knowledge Interest Identification
	Organizing the content is in alignment with the target group/learning objectives	Macro-level Meso-level Micro-level
	Choice of modality is in alignment with the target group/learning objectives	Multimedia principle Modality principle Coherence and redundancy principle Proximity principle
Didactic approach	Choice of learning activities is in alignment with the target group/learning objectives	Alignment with learning objectives Structure in the assignments Account for individual differences

	Choice of instruction strategies is in alignment with the target group/learning objectives	Prior knowledge Attention Processing learning material Motivation Feedback Reflection Individual differences Adaptivity
	The learning process is regulated	Preparation Planning Monitoring Evaluating
Design and presentation	Representation in texts are understandable, given the target group	Lexical Syntatic Semantic Digital texts
	Representation in images support comprehension	Decorative illustrations Representational illustrations Organizational illustrations Interpretational illustrations
	Lay-out is aimed at stimulating attention and structuring of information	Attention Structure

Each item is answered on a 4-point scale ranging from 1 = completely disagree to 4 = completely agree (5 = not possible to judge and 6= not applicable). For each item it is assessed whether this aspect is more or less present in the learning material.

3.2 Validation

Since 1940 there is an ongoing debate about the concept of validity (Goodwin & Leech, 2003). Viewing validity as multidimensional and complex is more realistic and appropriate compared to the older view in which validity was seen as a one-dimensional concept (Goodwin & Leech, 2003). According to the American Educational Research Association (AERA), the American Psychological Association (APA) and the National Council on Measurement in Education (NCME) validity is defined as follows: "The degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of test" (AERA, APA, & NCME, 1999, p. 9). Furthermore, the process of

validation is characterized by: "… accumulating evidence to provide a sound scientific basis for the proposed score interpretations" (AERA, APA, & NCME, 1999, p. 9). It should be noted that in this definition of validity, the emphasis is put on the interpretations of test scores, in the way that the proposed uses are evaluated and not the test itself. Moreover, they postulate that this is the most fundamental consideration in developing and evaluating tests. However, this is contradictory to the article of Beck and Gable (2001) who claim that assessing the content validity is one of the most important steps in instrument development. This difference might be explained by the different operationalization of validity: "Validity refers to the degree of accuracy and appropriateness of inferences made from scores; is a unitary concept; is a matter of degree rather than an absolute, all-or-nothing determination; and requires multiple types of evidence before a judgment can be made regarding the validity of a measure for a particular use or interpretation" (Goodwin, 1997). Although both definitions stress the notion of interpretation and inferences, and multiple sources of evidence, the difference is that the first emphasizes the interpretation of scores and multidimensionality and the second the content validity and one-dimensionality. In the definition of validity, this study will focus on multiple types of evidence, multidimensional aspects and content validity. Therefore, the first definition of AERA, APA and NCME (1999) is accepted with a main focus on content validity. According to Beck and Gable (2001), content validity stresses "the degrees to which items in an instrument adequately represent the domain of content" (Beck & Gable, 2001). Moreover, they state that content validity should be assessed in the developmental phase of the instrument rather than evaluating its final form.

To assess whether an instrument is valid, different sources of evidence can be evaluated. For instance, Goodwin and Leech (2003) identified five types of validity evidence. *Evidence based on test content* is based on logical analyses and experts' evaluations of the content, such as items, tasks, formats, wording and processes. *Evidence based on response processes* focusses on "the extent to which the tasks or types of response required of examinees fit the intended, defined construct'' (Goodwin & Leech, 2003, p. 184). Information about this type can be collected through interviews and observations. *Evidence based on internal structure* uses confirmatory factor analysis to examine if the internal components of an instrument match the defined construct (Goodwin & Leech, 2003). *Evidence based on relations to other variables* is obtained from correlational studies and similar instruments or measurements aimed at examining the same construct (Goodwin & Leech, 2003). The last type of evidence is *evidence based on the consequences of testing* in which anticipated and unanticipated consequences are identified (Goodwin & Leech, 2003) for instance with the use of focus groups (Chudowsky & Behuniak, 1998).

4. Recommended procedure

In literature there is a lack of information about standardized validation procedures (Akkerman et al., 2008) and only minimal guidelines about number of content experts, training of the experts and collection and analysis of content-related evidence are presented (Goodwin & Leech, 2003). Therefore, good practices about instrument validation are analyzed and integrated in the procedure. In the article of Beck & Gable (2001) data from the Postpartum Depression Screening Scale (PDSS) are used and a six-step procedure of content validity is described. This study is used as an illustration.

Based on theory, a validation procedure for the MILQ is developed. All recommendations are supported by or grounded with scientific evidence. The six-step procedure of Beck and Gable (2001) formed the basis for the recommended validation procedure, since this procedure was used previously when validating an instrument and it combines evidence from various scientific studies. The procedure starts from the beginning of developing an instrument. In this way, CLU can repeat the whole process when they want to update the MILQ. To illustrate the procedure the example of the first dimension *Quality of the content* and the third learning function *Choice of modality is in alignment with the target group/learning objectives.*

In the remainder of this section, different steps are described and provided with scientific support. This section concludes with a summary and a table in which all steps are outlined.

4.1 Step 1: Specify content domain

First of all, the content domain needs to be specified and a precise definition of the domain is crucial. This can be done by determining and/or adapting the definition of the key concepts in the MILQ: *Learning material,* the dimensions (*Quality of the content*, *Didactic approach*, and *Design and presentation*) and the learning functions (see Table 1). Moreover, defining the content domain and establishing definitions requires a comprehensive literature study. A thorough literature study on the topic being measured is necessary to ensure that all dimensions and sub-dimensions are identified (Lynn, 1986).Therefore, definitions and reasons to include dimensions and learning functions should be based on scientific evidence. An example of the first step is:

Definition *learning material:* 'Learning materials are texts and/or images meant for the facilitation of learning, in the sense that the content is selected and organized for reaching the learning objectives, and incite to the execution of learning activities and activities that regulate learning' (Reints, 2008, p. 30).

Definition of *quality of the content:* '…' (Reference). Research shows the importance of examining the quality of the content since good learning materials contribute to effective learning (Reints & Wilkens, 2012).

Definition of c*hoice of modality is in alignment with the target group/learning objectives:* '…' (Reference). According to Mayer and Moreno (2003), there are several important principles when using multimedia: Multimedia, modality, coherence, proximity, personality and redundancy.

Figure 1. Example of step 1 in the validation procedure.

4.1.1. Literature study

An important part of the first step is conducting a comprehensive literature study. Therefore, extra attention is paid to the process of conducting an adequate literature study. For this step the book *Systematic Approaches to a Successful Literature Review* of Booth, Apaioannou and Sutton (2012) is recommended since this book is helpful in developing expert search skills (MacDonald, 2013). Moreover, both theoretical and practical guidelines are described in the book.

In the first place, Booth, Apaioannou and Sutton (2012) define a systematic review as: Explicit, transparent, methodical, objective, standardized, structured and reproducible. It is recommended to use these concepts as a basis for literature study since this enhances the quality of validation. The type of research which entails the initial validation process is called 'systematic search and research', which "combines strengths of critical review with comprehensive search process''. Moreover, it "addresses broad questions to produce best evidence synthesis'' (Grant & Booth, 2009). This type of review is aimed at discovering what is known about the topic. When updating the MILQ a more 'state-of-the-art review approach' can be adopted in which the aim is to address current matters which "may offer new insights of specific issues or point out areas for further research" (Grant & Booth, 2009).

Furthermore, Booth, Apaioannou and Sutton (2012) also identified several stages in conducting a systematic literature study. In the *search* phase researchers should take sufficient time to define the best descriptors and identify the sources to use in the review literature related to the topic and report the search procedures that were used in the literature review. In the *appraisal* phase primary instead of secondary sources should be

used in reviewing the literature and another researcher's findings, interpretations, research design and analysis have to be critically examined to see if they are valid and sound. In the *synthesis* phase researchers have to consider contrary findings and alternative interpretations in synthesizing quantitative or qualitative literature. In the last phase *analysis,* researchers should clearly relate the findings of the literature review to the researcher's own study.

Based on literature, a template for conducting a systematic literature review was developed (see Table 2). This template can serve as global guidelines in validating a specific learning function of the MILQ. However, since the MILQ consists of nine different learning functions no concrete guidelines were possible. It is recommended that when the learning functions of the MILQ are actually validated, more concrete criteria should be formulated.

Table 2.

Template for Conducting a Systematic Literature Review

Section	Action
Background	• Explain why there is a need for a study on this topic • Specify the main research question being addressed by this study • Specify any additional research questions that will be addressed • If extending previous research on the topic, explain why a new study is needed
Search strategy	• Specify and justify basic strategy: Manual search, automated search, or mixed • For automated searches, specify search terms and compounds of these • For automated searches, identify resources to be used (digital libraries and search engines) • For manual searches, identify the journals and conferences to be searched • Specify how the search process is to be evaluated (e.g. against a known subset of papers; or against the results from a previous systematic review)
Selection criteria	• Identify the inclusion criteria (i.e. criteria used to include articles in the literature study) • Identify the exclusion criteria (i.e. criteria used to exclude articles in the literature study)

Quality assessment	• Critically examine the quality (i.e. validity, soundness, reliability) of the findings, interpretations, research design and analysis of the articles.
Synthesis	• Specify the form of analysis to be used (e.g. narrative, tabulation, meta-analysis) • Assess the threats to validity (construct, internal, external), particularly constraints on the search process and deviations from standard practice
Limitations	• Specify problems and limitations of the literature study

Moreover, it should be noted that the literature study should be incorporated within a balanced time, quality and money framework (Booth, Apaioannou, & Sutton, 2012). Additionally, in the literature there is a lack of information about what the minimum amount of articles is in a literature study. Nevertheless, they do address the concept of saturation which means that a researcher should keep reading and including literature until no new information is found. This is also in alignment with the current experiences of validation of the MILQ, since literature on the one learning function is more extensive than another learning function.

4.2 Step 2: Domain and item specification

The second step *domain and item specification,* several strategies are presented to delineate an instrument's content domain. A facet-design approach (Guttman, 1969) is used to identify fixed categories within the content domain and connected with a mapping sentence. Subsequently, variable elements within each category need to be established. The item-form/item-frame approach of Osburn (1968) can be used when generating items within a domain by incorporating variable and fixed components. The outline of the frame is fixed and contains one or more variable elements. The variable elements should lead to a definition of a group of item sentences. An advantage of this approach is that the content domain is defined and it is visible how the items are generated (Beck & Gable, 2001). Thus, the domain and items should be specified by determining and/or adapting the dimensions and learning functions. Depending on the results of the literature study, new aspects or variables might be related to learning materials, the dimensions or the learning functions. Table 1 can be seen as the fixed item-frame in which relevant variable concepts are included. A theoretical foundation can be made by connecting the concepts to each other. An example of the second step is:

Table 1.

Dimensions and Learning Functions of MILQ with their Underlying Concepts

Dimensions	Learning functions	Concepts
	Choice of modality is in alignment with the target group/learning objectives	Multimedia principle Modality principle Coherence and redundancy principle Proximity principle Addition: Characteristics of the target group (reference)

Figure 2. Example of step 2 in the validation procedure.

4.3 Step 3: Generate conceptual and operational definitions

In the third step, Beck and Gable (2001) (*using qualitative studies for domain specification*) used multiple qualitative studies for triangulation, in order to provide a more complete and holistic description of the emotional dimensions of the PDSS. This step was omitted in the validation procedure of the MILQ, because it is assumed that the underlying dimensions of the MILQ are less subjective to differences in human behavior in contrast to their PDSS questionnaire. The third step in the recommended procedure, *generate conceptual and operational definitions,* should be done in a similar way as step 1. Only in this step conceptual definitions are made for the underlying concepts of the learning functions. However, it is important to operationalize both the learning functions and the underlying concepts. In order to illustrate the concrete meaning of the definition, examples can be provided.

Conceptual definitions should be based on combinations of theory, literature study, results of qualitative investigations and the researcher's experience (Beck & Gable, 2001). In contrast, operational definitions are the observations and measurements of the concepts. Waltz and colleagues (1991) proposed an approach in developing conceptual definitions. First, establish a preliminary definition followed by a literature study. Identify or develop exemplary cases and map the concept meanings (Waltz, Strickland, & Lenz, 1991; Beck & Gable, 2001). After establishing the dimensions of the instrument, the fourth step is aimed at *generating items* for each of the dimensions. The operational definitions of the concepts should form the basis from which the items will be derived. An example of the third step is:

Operational definition of c*hoice of modality is in alignment with the target group/learning objectives:* The learning material is presented in text, image or sound (reference) and is suitable for the specific target group (Jonassen, Howland, Marra & Crismond, 2008).

Operational definition of *multimedia principle:* Using more modalities is better than using one modality (Mayer & Moreno, 2003).

Figure 3. Example of step 3 in the validation procedure.

4.4 Step 4: Generate items

In the fourth step *items* should be generated. These items have to be derived from the conceptual and operational definitions as formulated in step 4. An example of the fourth step is:

Item1: More than one modality is used to present the learning material.
Item 2: …

Figure 4. Example of step 4 in the validation procedure.

4.5 Step 5: Obtaining judgmental evidence

The last step in the content validity procedure is *obtaining judgmental evidence* on content validity. Beck and Gable (2001) mentioned four sources of evidence: Use of content experts, empirical techniques, use of index content validity and average congruency percentage.

First, content experts can be used to assess the quality and representativeness of the items within an instrument (Beck & Gable, 2001). This is the most frequently used approach. To assess the quality and representativeness of the MILQ also content experts can be used. The MILQ is presented to the content experts and they will have to assess whether they think the MILQ has sufficient and adequate items to be representative of the content domain and enables good quality measures. These experts have to evaluate the MILK without prior knowledge about the instrument, because they have to use their subject knowledge in order to give an objective judgment.

Second, empirical techniques such as latent partition analysis (Wiley, 1967) could be conducted. This procedure sorts the content experts' items in mutually inclusive content categories and analyzes if there is an underlying meaningful content. Thus, in other words examining if there is a relationship between sets of items. Also in the case of the MILQ this can be a valuable empirical technique.

Third, the index of content validity (CVI) can be used (Beck & Gable, 2001). Experts' rating of the content relevant items are measured with a 4-point Likert scale ranging from 1 = not relevant to 4 = very relevant. The CVI is the proportion of items on an instrument that achieved a rating of 3 or 4 by the content experts (Beck & Gable, 2001). CVI is acceptable with a score of at least .80 (Beck & Gable, 2001). It is advised to use

experts that are not familiar with the MILQ in order to ensure a more objective assessment of the validity. Relevant experts could be educationalist, developers of learning materials, teachers and researchers involved in the area of learning materials. Moreover, no guidelines are presented about the minimum or maximum number of content experts. However, it is recommended to use at least two experts in order to deal with subjectivity.

Last, content experts are asked to read the domain specifications and decide on the congruence with each item and its specifications (Popham, 1978). For each expert the proportion of items rated congruent is computed and combined with the percentages of other content experts (Beck & Gable, 2001). This is also an approach suitable for validating the MILQ. The mean percentage of all experts should be at least 90% in order to be acceptable (Waltz et al., 1991). Low percentages of agreements should raise questions: Take a closer examination of the scoring pattern and check the accuracy of each content expert by creating irrelevant items.

4.6 Summary

In literature there is a lack of information about standardized validation procedures (Akkerman et al., 2008) and only minimal guidelines about number of content experts, training of the experts and collection and analysis of content-related evidence are presented (Goodwin & Leech, 2003). Therefore, good practices about instrument validation are analyzed and integrated in the procedure. Based on the theoretical framework presented above, a validation procedure for the MILQ is developed. All recommendations are supported by or grounded with scientific evidence. The six-step procedure of Beck and Gable (2001) formed the basis for the recommended validation procedure, since this procedure was used previously when validating an instrument and it combines evidence from various scientific studies. The procedure starts from the beginning of developing an instrument. In this way, CLU can repeat the whole process when they want to update the MILQ. Table 2 summarizes the recommended procedure and provides practical guidelines for applying it.

Table 3.

Five-Step Procedure Specific for Validating the MILQ

Step	What	How
1	Specify the content domain	• Determine and/or adapt a precise definition for: o *learning material* o the dimensions *quality of the content*,

		didactic approach, and *design and presentation* ○ the learning functions (see Table 1)
1a	Conduct a comprehensive literature study	• Investigate recent literature about *learning material,* the dimensions and the learning functions. Incorporate new findings and evidence into the existing theoretical framework. Use the template presented in Table 2 as a guideline.
2	Use domain and item specification strategies	• Determine and/or adapt the framework of the MILQ. Include the dimensions based on the conducted literature study. • Determine and/or adapt the variable elements within the outlined framework. Include the learning functions based on the dimensions and the conducted literature study. Use the item-form/item-frame approach: ○ Make and/or adapt a fixed item-frame (includes one or more variable elements (e.g. the concepts)). ○ Connect the group of concepts with a sentence/definition.
3	Generate conceptual and operational definitions	• Establish and/or adapt the conceptual and operational definitions for each learning function and underlying concepts. Include exemplary cases to illustrate the meaning of the learning functions and the underlying concepts.
4	Generate items	• Generate and/or adapt the items of the MILQ based on the conceptual and operational definitions.
5	Obtain judgmental evidence	• Use content experts to judge the quality and representativeness of the MILQ. • Use Average Congruency Percentage to estimate the content validity of the MILQ. Acceptable ACP ≥ 90%. • Additional: Use the Content Validity Index to judge the content relevance of the MILQ.

	Acceptable CVI ≥ .80.

5. Conclusion and discussion

This validation report was conducted by order of CLU, Center for Textbook Studies (in association with Utrecht University). The MILQ, developed by CLU, is an instrument for assessing the effectiveness of learning materials. However, parts of the MILQ still need to be validated. As a result, CLU wanted a standardized procedure for validating the MILQ in order to ensure a well-founded and valid measurement instrument. Therefore, this study addressed the following questions: *What validation procedure is best suitable when validating the MILQ? And how can the validation of the instrument stay up-to-date?*

Literature study revealed that there is an ongoing debate about the concept of validity (Goodwin & Leech, 2003) and that there are no standardized procedures about what appropriate validation entails (Akkerman et al., 2008). Therefore, different studies about instrument development, validation and conducting a literature study are combined, integrated and discussed in order to develop a standardized procedure. The article of Beck and Gable (2001) and the book of Booth, Apaioannou and Sutton (2012) formed both a foundation for the recommended procedure. Thus, all recommendations are supported by or grounded with scientific evidence. In addition, it is also important to note that the procedure starts from the beginning of developing an instrument which is useful when CLU wants to up-date the MILQ.

Thus, answering the first research question: The validation procedure presented in Table 2 is best suitable for validating the MILQ. This procedure is based on a combination of the good practices of Beck and Gable (2001) and the book of Booth, Apaioannou and Sutton (2012). This procedure is theoretically grounded but provides practical guidelines when CLU wants to use the procedure. The second research question is answered by stating that the validation procedure can be repeated in order to keep the MILQ up-to-date. However, only when the literature study reveals new or contrary evidence in the field of interest it is recommended to repeat the whole process. Otherwise, it is advised to continuously read scientific articles and journals in order to see if the field is changing. Thus, a researcher should know about the current developments in the scientific field to assess whether readjustment of the MILQ is necessary.

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