

Exploring the Argumentation Skills of Prospective Teachers based on Commognitive Approach using Moodle LMS

Andika Setyo Budi Lestari^{1,2}, Toto Nusantara¹, Susiswo Susiswo¹,
Tjang Daniel Chandra¹, Nonik Indrawatiningsih²

¹ Universitas Negeri Malang, Jl. Semarang No 5, Malang, Indonesia

² Universitas PGRI Wiranegara, Jl. Ki Hajar Dewantara No. 27-29, Pasuruan, Indonesia

Abstract – While a pandemic is currently sweeping the world, technology becomes a necessity in almost the entire aspects of life, particularly in learning activities. One of conventional learning-based platforms that adopt online system is Moodle Learning Management System. This study explored the argumentation skills of prospective teachers based on commognitive approach using the LMS. This qualitative research used online-based semi-structured questionnaire and interview during a discussion group via LMS platform. The subjects of this study were 38 prospective teachers. The research instrument was a questionnaire with eight items. It was initially assessed with Cronbach's alpha test in which the value indicated the questionnaire was reliable (0.852). The findings of this study indicate the argumentation skills of prospective teachers correlate with the commognitive framework, including claim with endorsed narratives; data with visual mediators; warrant with routine, word use, and endorsed narratives; and backing with endorsed narratives.

Keywords – exploration, argumentation skills, commognitive, LMS, Moodle, prospective teacher.

DOI: 10.18421/TEM103-46

<https://doi.org/10.18421/TEM103-46>

Corresponding author: Toto Nusantara,
Universitas Negeri Malang.


Email: toto.nusantara.fmipa@um.ac.id

Received: 08 March 2021.

Revised: 03 August 2021.

Accepted: 09 August 2021.

Published: 27 August 2021.

 © 2021 Andika Setyo Budi Lestari et al; published by UIKTEN. This work is licensed under the Creative Commons Attribution-NonCommercial-NoDeriv 4.0 License.

The article is published with Open Access at www.temjournal.com

1. Introduction

Since its emergence in 2019, the COVID-19 has spread to nearly every country in the world. However, the outbreak has not only impacted the health and economic sectors but also the education sector. All elements, regardless of their willingness or readiness, must live side by side and accept the conditions brought by the current pandemic.

While the pandemic is sweeping the world, technology has been an inseparable part in many aspects of life. In the field of education, technology is essential and has impact on knowledge improvement [1]. During the pandemic, technology assists every aspect of everyday life. It is also useful in the fields of economics, health, law, and communication. Particularly in the field of education, technology applications are frequently linked to the term of educational technology [2], [3].

Today, technology has become an integral part of education, to mention the use of computers, mobile phones, the Internet, and videos among the daily lives of students and educators, so that skills are needed to optimally utilize the available technological tools [1]. Since technology plays an important role in learning activities, prospective teachers are required to acknowledge and be familiar with technology application and optimization. The pandemic will end in the future and technology will be increasingly attached to the aspects of life, particularly for prospective teachers who have to utilize technology in carrying out quality learning for students [1], [4].

The attempts to accomplish learning by utilizing technology involve several factors, including the selection of the application. This factor includes ease of administration, ease of management, documentation and evaluation [5]. Before the pandemic, most of learning activities occur in conventional methods and less technology application. Currently, online learning by utilizing technology is more dominant, even a necessity.

One of the online learning platforms that adopts conventional learning but currently uses online system is the learning management system (LMS). It is equipped with features to assist teachers in compiling teaching model and to assist students to learn independently [6], [7]. The LMS records all learning activities conducted by students and teachers, as well as the data of student interaction, including when, how long and how often they access files in the form of materials, quizzes, virtual classes, and other similar activities. It is also helpful for teachers to track and monitor the student learning process.

In online learning, however, the use of the LMS is ineffective without the presence of good lesson planning. It must be arranged to increase student activity in learning. Student activeness in online learning is identified from student responses and activities as displayed by student interactions—which has an important role in online learning [8].

The online learning system does not impede prospective teachers to improve their argumentation skills. In fact, the features in LMS allow prospective teachers to enhance such skills. Mathematical argumentation skills are one of the most important elements of critical thinking [9]. It covers a process of logically connecting statements that aim to persuade or convince other people. Arguments play an important role in mathematical reasoning [10]. Several components in argumentation skills, namely claim, data, warrant, and backing [11]. Claim is a statement or decision held by the person in argument. Data is facts that support the statement. Warrant is an explanation of the relationship between data and statements. Backing is the basic assumption to support the warrant.

To assess the argumentation skills of students, the commognition framework is frequently applied. It is based on the concept of thinking as a cognitive activity while answers are a form of communication conveyed by students. Commognition is a blend of communication and cognition [12], [13]. It can be defined as the conveyance of ideas that can be expressed in written or spoken form [14], [15].

Ideas expressed by students are presented in written form. To analyze the argumentation skills of students in critical thinking, commognition is used. Subsequently, four features were included in analyzing the answers conveyed by students, namely visual mediator, word use, routines, and endorsed narrative [16].

Visual mediator is a tangible form of student work. Visual mediators are distinguished into three categories: concrete mediators, symbolic mediators, and iconic mediators [12], [17], [26]. Concrete mediators can be in the forms of real or familiar objects such as rulers, fingers and other objects to

count. The example of symbolic mediators is the symbolic expression in algebraic calculations. Meanwhile, iconic mediators can be in the forms of graphs, diagrams, figures, or sketches.

Word use is a term or word usage {Formatting Citation}. In this context, word use is the use of words or terms in mathematics. In addition to the visual mediator, word use has an important role since it determines the solution to a given problem [18].

Routines are the habits carried out by a person when solving a problem [13], [19]. Routines can be recognized from the answers written by students or the results of interviews with students. Briefly, routines can also be seen from the visual mediator.

Endorsed narratives are descriptions or explanations of word use [20]. In addition to being able to obtain explanations, endorsed narratives are useful to explore students' level of understanding. If a student is able to explain a concept appropriately, she/he is considered to understand the given problem.

The aim of the present study was to explore the argumentation skills of prospective teachers based on commognitive approach using Moodle Learning Management System.

2. Methods

The research method consists of subject selection, data collection tools, and data analysis. The present study is a qualitative study using online-based semi-structured interviews. Qualitative study is research that emphasizes more on the process instead of the works of the subjects [5]. In this study, semi-structured interview method was selected by considering its flexibility and to obtain in-depth information about the subjects.

This study was conducted at a higher education institution in Pasuruan, East Java, Indonesia. Specifically, 38 students of Mathematics Education study program of the 2020-2021 academic year. The subject selection of a qualitative study is done with sample selection technique based on the criteria according to the research objectives [5]. The research subjects were eight of 38 students of Mathematics Education who were selected according to the criteria that had been determined in the odd semester of the 2020-2021 academic year. The selection was based on the assessment of student works with the indicators of argumentation skills, namely claim, data, warrant, and backing. In addition, the record of student works in the Learning Management System (LMS) during the discussion was also observed.

Data collection instruments were online-based semi-structured questionnaire and interview guidelines using the Learning Management System (LMS). For interview guidelines, two experts of Mathematics Education were involved to validate the

instrument. It contained the addition problems of integers. The following are the problems and questions that have been validated by experts in accordance with the research objectives:

$$\text{Claim: } 14 + 12 = 26$$

Table 1. The Questions

No	Based on the problem, the questions are:	Commognition	Argumentation
1	In your opinion, is the claim true or false?	Endorsed narratives	Claim
2	Are you sure with your answer?	Endorsed narratives	Warrant
3	How do you prove it?	Endorsed narrative and routine, word use	Data
4	Can you provide another way to prove it?	Endorsed narrative and routine, word use	Warrant
5	Explain about it?	Endorsed narratives	Backing
6	How if the number is replaced by another number?	Routine	Warrant
7	Can you provide another example?	Endorsed narratives	Data
8	What is the conclusion?	Endorsed narratives	Backing
Assessed based on the works of prospective teachers		Visual mediator	

The data collection was carried out according to a predetermined schedule to facilitate the subjects in expressing ideas and thoughts. In addition, due to the pandemic, interviews were conducted online using a Learning Management System/LMS platform. Initially, five open-ended questions were distributed to the research subjects. Furthermore, during the discussion, several additional questions were posed to explore the skills of the subjects. Totally, ten online meetings were carried out.

Interviews were conducted online and all activities were recorded using the Learning Management System/LMS. The data were subsequently processed, while the data obtained from interviews were converted into transcripts. The data and findings obtained from the subjects' answers were classified based on how the subjects answered the questions. Analysis was done with commognition approach to examine the critical thinking of research subjects.

This analysis aimed to explain the relationship between the collected data and the research objectives. Content analysis involved the steps of coding, categorization and adjustment, in order to attain findings that can be defined and interpreted [21]. Through this content analysis, the frequency and percentage used in data interpretation were divulged.

Prior testing the questionnaire, the reliability of the instrument was tested using the Cronbach's alpha test. An instrument is reliable if the coefficient of Cronbach's alpha is more than 0.70 [27]. Based on the test, the instrument used in this study was declared reliable. Figure 1. presents the results of the Cronbach's alpha of the research instrument.

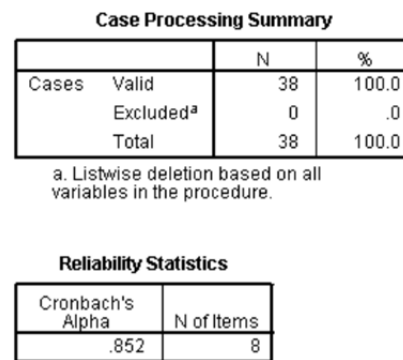


Figure 1. Cronbach's alpha to test research instrument

Figure 1. provides information on the number of samples (N) analysed using a computer program, namely 38 students or prospective teachers (N). Since the data are entirely fulfilled, the number is 100% valid. From the output, it can be seen that N is indicated from the items (the number of items or questions within the questionnaire). There are eight items with a Cronbach's alpha of 0.852. Since the value is more than 0.7, the reliability of the instrument can be concluded as reliable.

3. Result and Discussion

The results obtained from the data analysis on the argumentation skills of prospective teachers based on the commognition approach are presented below.

3.1. The Works of Prospective Teacher Based on Visual Mediators

Visual mediators are a tangible form of the works performed by prospective teachers. They can be classified into three categories: concrete mediators, symbolic mediators, and iconic mediators. Table 1. shows the data on the works of prospective teachers regarding their argumentation skills based on visual mediators.

Table 2. The works of prospective teachers based on visual mediators

Visual mediator	F (of 38 prospective teachers)
Concrete mediators	8
Symbolic mediators	38
Iconic mediators	5
Concrete mediators and symbolic mediators	1

Table 2. demonstrates the visual examination of the works of prospective teachers, particularly on how they solve the given problems. The table indicates that of the 38 prospective teachers, only one solved the problem with concrete mediator by using number lines and beads. Most students solved the given problem with symbolic mediators or known as algebra.

3.2. The Works of Prospective Teachers Based on Word Use

Examination of the works of prospective teachers found the word use, which included: number lines, addition, tens, units, integers, even numbers, odd numbers, compared, difference, subtracted, minus numbers, numbers, positive numbers, numbers negative, and equation.

Based on the examination, it can be known that word use or mathematical terms used by prospective teachers when solving the given problem were common terms in mathematics. Therefore, the possibility of misperception was small.

3.3. The Works of Prospective Teachers Based on Routine

Based on the analysis of the works of and interviews with prospective teachers, most of them solved the given problem using symbolic mediators. Figure 2. below shows the results of the works using symbolic mediators.

To prove $14 + 12 = 26$, then:
 Even number + even number will always equal an even number,
 therefore it is impossible $14 + 12$ will equal an odd number.
 To prove that $14 + 12 = 26$ is as follows:
 14 consists of 1 ten + 4 ones
12 consists of 1 ten + 2 ones +
 2 tens + 6 ones

Figure 2. The work of prospective teachers based on symbolic mediators

Figure 2. shows prospective teachers used algebra in solving the given problem, instead of using concrete mediators or real objects. It seemed that

they were not accustomed to employ familiar objects or iconic mediators by drawing pictures or sketches. Figure 3. shows the work of a prospective teacher using concrete mediators, namely by using number lines.

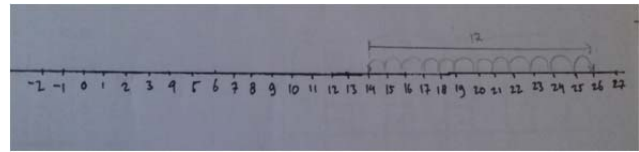


Figure 3. The work of prospective teacher using concrete mediator

3.4. The Work of Prospective Teacher Using Endorsed Narratives

The required skills of prospective teacher include the ability to explain and argue an idea as well as to provide other examples. To investigate such skills, prospective teachers were posed to several questions as presented in Table 3.

Table 3. The responses of prospective teachers based on endorsed narratives

No	Questions	F (yes)	F (no)
1	In your opinion, is the claim true or false?	38	-
2	Are you sure with your answer?	36	2
3	How do you prove it?	29	9
4	Can you provide another way to prove it?	26	12
5	Explain about it?	25	13
6	How if the ratio is replaced by another number?	17	21
7	Can you provide another example?	9	29
8	What is the conclusion?	8	30

Table 3. shows the questions used to explore the ability of prospective teachers on how to solve and provide an explanation when solving the given problem. Figure 4. shows the work of a prospective teacher using endorsed narratives.

There is another way to prove $14 + 12 = 26$, namely By comparing two numbers.
 14 is compared to 15 \rightarrow the difference is 1
 12 is compared to 15 \rightarrow the difference is 3
 $15 + 15 = 30$ (1)
 $1 + 3 = 4$ (2)
 From (1) and (2), then $30 - 4 = 26$

Figure 4. The work of a prospective teacher using endorsed narratives

Figure 4. shows the ability of prospective teacher in providing an alternative to solve the given problem by comparing the two numbers. From the comparison of the two numbers, the truth of the claim can be proven. Based on the commognitive approach, this method can be classified as a tie endorsed narrative, namely by using another term: comparing two numbers to prove a claim. Figure 5. is a reconstruction of the argument based on commognitive analysis.

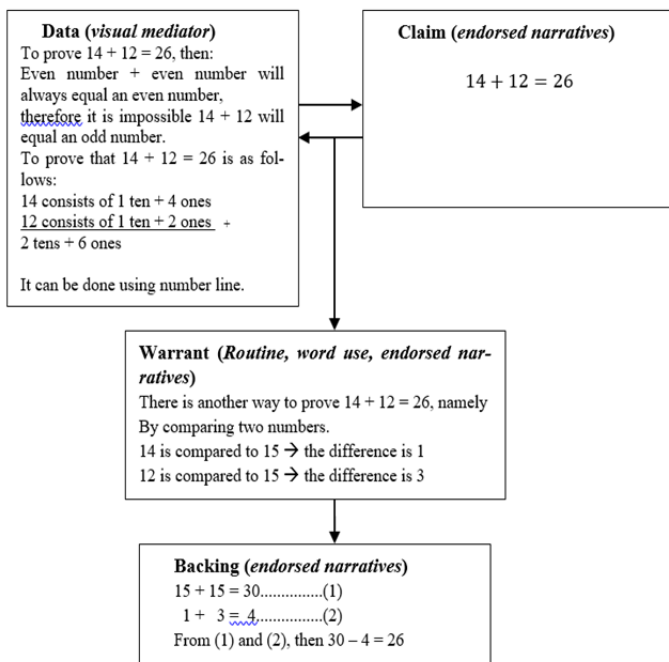


Figure 5. Reconstruction of argumentation based on commognition analysis

Based on Figure 5., the argumentation skills of prospective teachers can be identified through the identification model. The model is summarized as follows: a) Claim: prospective teacher is able to identify whether a claim is true or false, b) Data: prospective teacher is able to provide supporting data to reaffirm that the claim is true or false, c) Warrant: prospective teacher is able to provide alternative/s by showing evidence, d) Backing: prospective teacher is able to conclude that the claim is true or false and provide other standpoints to prove that claim.

This study aimed to investigate the argumentation skills of prospective teacher based on commognitive approach through learning activities using the LMS platform. The data obtained from the platform have been analyzed visually, showing the propensity of prospective teachers to solve problems using symbolic mediators or algebra. Regarding the argumentation skills of prospective teachers, they are able to provide proof by collecting supporting data. This is in accordance with [22] on the indicator for assessing argumentation skills in which prospective teachers are able to collect data/evidence to support

claims. In the present study, only a few prospective teachers solved problems by drawing, sketching, or using concrete mediators. The selection of mediators has an important role in solving the given problems [23]. Factors contribute to the ways prospective teachers solved the given problems are varied, including imitating or following particular models or previous experiences [23], which eventually became a routine for prospective teacher in solving problems. Nevertheless, some of prospective teachers were identified to apply concrete mediator such as number lines. During the discussion session, the use of such mediators was also promoted to add the insights of prospective teachers.

Concerning visual mediators, as indicated by their works, prospective teachers have demonstrated their argumentation skills as a part of critical thinking. Furthermore, to ensure the argumentation skills of prospective teachers, further assessment has been done by checking the word use as well as the capability to explain the meaning and intent of prospective teachers in writing their answers.

Based on the answers written by prospective teachers, they seemed to be familiar with several terms, which can be identified as word use. The word use entails terms that are commonly used in mathematics. Word use also has an important role in solving problems [24], [25]. It is crucial since inaccurate word use will result in different meanings or misunderstanding. As prospective teachers are able to determine the word use, it is an indicator that they are at the warrant stage, namely statements that explain the relationship between claims and data {Formatting Citation}.

In order to obtain deeper information about the answers and intention of prospective teachers, clarification was required. It was done to ensure the correctness of the answers (endorsed narratives). Endorsed narratives are an approach that can be done to explore one's knowledge. The initial question posed to prospective teachers included whether the claim presented in the given problem was true, in which all prospective teachers answered correctly. At this stage, it can be declared that they have adequate knowledge about what they have written down. Subsequently, further question was posed to find out the level of surety of prospective teachers regarding their answers. Most of them were convinced that they answered the question correctly. To find out more information, they were inquired whether they could prove it, in which most of them could attest. As they were inquired about any possible alternatives to solve the given problem, most of them could provide them. Based on their answers, it can be claimed that prospective teachers have met the criteria of backing.

4. Conclusion

Based on the results of this study, it can be concluded that online learning platform such as Moodle LMS can be used to reveal the argumentation skills of prospective teachers as analyzed using a commognition approach. The analysis of the argumentation skills of prospective teachers based on commognition approach has been carried out, revealing: First, claims can be perceived as endorsed narratives. Second, data can be perceived as visual mediators. Third, warrant can be perceived as routine, word use, and endorsed narratives. Fourth, backing can be perceived as endorsed narratives.

Furthermore, the findings of this study emphasize three points. First, commognitive framework can be an alternative approach to explore and identify the argumentation skills of students in general. Second, the level of argumentation skills can be identified using commognitive approach. Third, it is suggested for subsequent studies to dissect the leveling of students' argumentation skills based on commognitive framework.

References

- [1]. Wieland, N., & Kollias, L. (2020). Online Learning Before, During and After COVID-19: Observations Over 20 Years. *Int. J. Adv. Corp. Learn.*, 13(2), 84-92.
- [2]. Reiner, M. (2009). Sensory cues, visualization and physics learning. *International Journal of Science Education*, 31(3), 343-364.
- [3]. Goos, M., Galbraith, P., Renshaw, P., & Geiger, V. (2003). Perspectives on technology mediated learning in secondary school mathematics classrooms. *The Journal of Mathematical Behavior*, 22(1), 73-89.
- [4]. Engelbrecht, J., Llinares, S., & Borba, M. C. (2020). Transformation of the Mathematics Classroom with the Internet. *ZDM: The International Journal on Mathematics Education*, 52(5), 825-841.
- [5]. Clift, R. T., Mullen, L., Levin, J., & Larson, A. (2001). Technologies in contexts:: implications for teacher education. *Teaching and teacher education*, 17(1), 33-50.
- [6]. Ulfa, S., & Fatawi, I. (2021). Predicting Factors That Influence Students' Learning Outcomes Using Learning Analytics in Online Learning Environment. *International Journal of Emerging Technologies in Learning (iJET)*, 16(1), 4-17.
- [7]. Aldowah, H., Al-Samarraie, H., & Fauzy, W. M. (2019). Educational data mining and learning analytics for 21st century higher education: A review and synthesis. *Telematics and Informatics*, 37, 13-49.
- [8]. Zimmerman, T. D. (2012). Exploring learner to content interaction as a success factor in online courses. *International Review of Research in Open and Distributed Learning*, 13(4), 152-165.
- [9]. Indrawatiningsih, N., AS'ARİ, A. R., & SA'DİJAH, C. (2020). Mathematical Argumentation Ability: Error Analysis in Solving Mathematical Arguments. *Journal for the Education of Gifted Young Scientists*, 8(2), 711-721.
- [10]. Chick, H., & McCrae, B. (2005). Argumentation Profile Charts as Tools for Analysing Students' Argumentations. *Proc. 29th Conf. Int. Gr. Psychol. Math. Educ.*, 4(281-288).
- [11]. Clark, D. B., Stegmann, K., Weinberger, A., Menekse, M., & Erkens, G. (2007). Technology-enhanced learning environments to support students' argumentation. In *Argumentation in science education* (pp. 217-243). Springer, Dordrecht.
- [12]. Mpofu, S., & Pournara, C. (2018). Learner participation in the functions discourse: A focus on asymptotes of the hyperbola. *African Journal of Research in Mathematics, Science and Technology Education*, 22(1), 2-13. <https://doi.org/10.1080/18117295.2017.1409170>.
- [13]. Sriraman, B. (2009). Book Review: What's All the Commotion Over Commognition? A Review of Anna Sfard's Thinking as Communicating. *The Mathematics Enthusiast*, 6(3), 541-544.
- [14]. Kim, D. J., Choi, S., & Lim, W. (2017). Sfard's commognitive framework as a method of discourse analysis in mathematics. *International Journal of Cognitive and Language Sciences*, 11(11), 481-485.
- [15]. Nardi, E., Ryve, A., Stadler, E., & Viirman, O. (2014). Commognitive analyses of the learning and teaching of mathematics at university level: the case of discursive shifts in the study of Calculus. *Research in Mathematics Education*, 16(2), 182-198.
- [16]. Thoma, A., & Nardi, E. (2016, March). Routines in the didactical and mathematical discourses of closed-book examination tasks. In *First conference of International Network for Didactic Research in University Mathematics*.
- [17]. Sinclair, N., & Moss, J. (2012). The more it changes, the more it becomes the same: The development of the routine of shape identification in dynamic geometry environment. *International Journal of Educational Research*, 51, 28-44.
- [18]. Pratiwi, E., Nusantara, T., SUSISWO, S., & Muksar, M. (2020). Textual and contextual commognitive conflict students in solving an improper fraction. *Journal for the Education of Gifted Young Scientists*, 8(2), 731-742.
- [19]. Viirman, O. (2015). Explanation, motivation and question posing routines in university mathematics teachers' pedagogical discourse: a commognitive analysis. *International Journal of Mathematical Education in Science and Technology*, 46(8), 1165-1181.
- [20]. Tasara, I. (2017). Commognitive analysis of a teacher's mathematical discourse on the derivative. *Proceedings of the British Society for Research into Learning Mathematics*, 37.
- [21]. Alibali, M. W., & Sidney, P. G. (2015). Variability in the natural number bias: Who, when, how, and why. *Learning and Instruction*, 37, 56-61.

- [22]. Sampson, V., & Gerbino, F. (2010). Two instructional models that teachers can use to promote & support scientific argumentation in the biology classroom. *The American Biology Teacher*, 72(7), 427-431.
- [23]. Lestari, A. S. B., Nusantara, T., Susiswo, S., & Chandra, T. D. (2019). Imitasi Dalam Komunikasi Matematis Siswa Untuk Menyelesaikan Masalah Matematika. *IndoMath: Indonesia Mathematics Education*, 2(2), 95-104.
- [24]. Caspi, S., & Sfard, A. (2012). Spontaneous meta-arithmetic as a first step toward school algebra. *International Journal of Educational Research*, 51, 45-65.
- [25]. Sfard, A. (2015). Learning, commognition and mathematics. *The Sage handbook of learning*, 129-138.
- [26]. Ho, W. K., Hong, L. S., Tay, E. G., Leong, Y. H., & Ming, K. (2019). Passing a Proof Message : Student-Teacher Communication Through A Commognitive Lens. in 42nd Annual Conference of the Mathematics Education Research Group of Australasia Incorporated (MERGA 2019) on “Mathematics Education Research: Impacting Practice”, (pp. 700–706).
- [27]. Kwon, O. N., Ju, M. K., Kim, R. Y., Park, J. H., & Park, J. S. (2013). Design research as an inquiry into students’ argumentation and justification: Focusing on the design of intervention. *Educational design research—Part B: Illustrative cases*. Enschede, The Netherlands: SLO.