Sense-making in the Production Process of Online Learning Materials

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1. The initial situation: the IDEN project and the INEMA study program

IDEN stands for *International Digital Education Network* and is a three-year project funded by the German Academic Exchange Service (DAAD) since 2020. The goal of the project is to (1) develop instructional materials for asynchronous online learning situations used in the International Educational Management (INEMA) degree program and (2) develop and evaluate a production process that allows a team to create these materials collaboratively. We assumed that the creation of online learning materials is too time-consuming to be done by lecturers in addition to their daily tasks, and that effective collaboration with instructional designers could reduce their workload. The IDEN core team consists of three instructional designers specializing in text production (TP), filming (F), and learning platform design (LPD), as well as the project manager, who also takes on a partial role as an instructor.

INEMA is a Master's program offered jointly by Helwan University in Cairo and the University of Education in Ludwigsburg since 2011 (Krüger & Tulowitzki, 2018). The 4–6 semester extra-occupational program is aimed at employees and managers in education and development cooperation. Its purpose is to develop managerial skills and competencies for cross-cultural challenges in education. The program is (a) non-consecutive (Hochschulrektorenkonferenz, 2014), i.e. students can be admitted even if they do not have a first degree in a pedagogical or business subject, and (b) application-oriented with a focus on theory-practice transfer and the promotion of students' action competence. Additionally, the target group of INEMA differs from typical students due to their life situation. They are employed (and remain so during their enrollment)

and have usually already started their own families – circumstances that place high demands on the time flexibility of studies. The program is designed to prepare graduates to take on leadership roles in education – for example, as a school principal, in the management of a non-governmental organization, or in a senior position in a ministry.

Approximately 21 students, from 10 to 15 different countries per cohort, come together six times for 10-day learning periods, alternating between the universities in Ludwigsburg and Cairo[1]. During these »attendance phases«, great emphasis is placed on intercultural learning. Lessons are very interactive, and German-Egyptian teaching tandems carry out the teaching. Students are asked to think about management problems in their workplace and try to apply the models they have learned in their course work. By sharing concepts and revealing underlying assumptions, they learn »through differences« – which is the program's motto[2]. The phases of face-to-face learning are prepared and followed up by online learning phases, where course content and assignments are offered. The IDEN project aims to optimize these online phases. However, to understand their full function within the constructive alignment of the INEMA program (Biggs & Tang, 2011), it is necessary to emphasize that the online phases additionally serve to prepare students for their academic term papers and, thus, also establish contact with a base of academic literature.

It should not be ignored that the travelling required to participate in the attendance phases leaves a significant environmental footprint[3]. The degree

1 The program emerged from a cooperation between Germany and the Mena region (Middle East and North Africa). Through the support of the DAAD funding line EPOS (Development Related Postgraduate Studies) it was possible to open the program to students from less privileged countries who receive a scholarship through the DAAD. Since then, students from an average of 15 different countries have participated in INEMA courses.

2 The principle of »learning through differences« (Krummenauer-Grasser & Schweizer, 2008) underscores the innovative power that unfolds in learning projects when people with different perspectives work together on a topic. The INEMA study program deliberately works with groups that have very different cultural and professional backgrounds. For example, an employee from the Egyptian Ministry of Education is working together with an educator from Italy, an instructional designer from Colombia and a Pakistani social worker to develop an information campaign against the burning of plastic waste in rural areas of Pakistan.

3 To travel to Ludwigsburg and back, the students collectively covered 210,000 kilometers in the summer of 2022, corresponding to CO2 emissions of 42.7 tons. (Distance calculator: www.luftlinie.org, for CO2 calculation: www.atmosfair.de). When travelling

program therefore plans to conduct two of the six attendance phases online (in synchronous settings) in the future.

2. Complementary learning opportunities in a blended learning format

The characteristics of the INEMA program illustrate that the opportunities and limitations of its online and attendance phases are almost complementary. For example, the online learning phases provide little opportunity to initiate exploratory learning settings or support sense-making processes (Weick 1995) among students[4]. However, due to the high cultural diversity of the participants, the face-to-face phases of the program offer outstanding opportunities for confronting one's thinking patterns with the sense-making processes of other participants. During the online phases, learning processes can be extended and accompanied over several weeks and months. Pauses between learning units can be scheduled, and the setting offers good opportunities for a systematic repetition of content. Meanwhile, attendance phases usually do not allow time for a slow and steady learning process. Other characteristics of the two phases are listed in Table 1.

Table 1

Online learning phases	Attendance phases
Possibility of planning short and sequential learning units that can be mastered alongside the demands of everyday life.	Participation in attendance phases requires time-consuming planning by students (arrangements with family and employer, travel arrangements).
Possibility of long-term learning support over several weeks or months.	Chance to provide profound learning stimuli.

to Egypt, distances are a bit different. Overall and on average, one can assume a CO_2 footprint of 40 tons per attendance phase.

4 Sensemaking, as defined by Weick, Sutcliffe and Obstfeld, is »the ongoing retrospective development of plausible images that rationalize what people are doing« (Weick, Sutcliff & Obstfeld, 2005, 409).

Online learning phases	Attendance phases
Good opportunities for repetition and reinforcement.	Little opportunity for repetition and reinforcement.
Opportunity to become familiar with basic terms and models of the subject area.	Limited opportunities for systematic introduction and grounding of basic concepts.
Hardly any opportunities for the shared process of sense-making. Solitary learning carries the risk of becoming stuck in one's thought patterns.	Excellent opportunities for shared sense-making by applying theoretical knowledge to real practical cases and comparing different participants' solutions.
Difficulties in activating learning. Higher demands on the self-motivation and discipline of learners.	High student motivation to learn. This is likely due to group work and active involvement.
Reduced environmental, organizational, time and financial burden.	Higher environmental, organizational, time and financial burden.

3. Consequences for the fit of online materials into the given setting of learning

The complementary characteristics of the two learning phases prompted us to not try to imitate attendance phases in an online setting. We felt it made more sense to build on the specific strengths of online teaching, and thereby compensate for some of the weaknesses of face-to-face teaching. First, however, we documented some of the requirements for online learning that arise from the specific structure of an in-service degree program:

Start from scratch and increase the pace: Since learners come from different professional fields (kindergarten, school, vocational training, university, educational administration, human resources management in companies, etc.) and no common expertise can be assumed, learning units must always start at a »basic level«. However, learners are already trained in scientific/academic thinking and the organizing of their learning process, and therefore, fast and self-directed learning can be expected.

Time-boxing: Since learners study parallel to their family and work commitments, learning units must be easy to schedule. Regular and short learning

phases are easier for students to organize than weakly structured learning scenarios.

Singular learning: During online learning phases, learners join from up to 12 different time zones. Synchronous learning scenarios must therefore be used very sparingly. Asynchronous networking also quickly reaches its limits, increasing learners' dependence on each other's learning pace. Conflicts arising from broken agreements cannot be adequately resolved in the online setting. However, consultations with teachers are possible.

Reference to face-to-face teaching: The online teaching materials do not stand alone. They serve as a preparation for the face-to-face lessons and/or tie in with them. The content covered in the attendance phases must be considered when designing the online learning units.

Constructive alignment: The online teaching materials also prepare students for their academic papers. Thus, another function of the online materials is to introduce students to the literature in the respective field of knowledge.

4. The function of online teaching materials in the light of Bloom's Taxonomy

To determine the function of our online learning units, we used Bloom's Taxonomy as a guide in its revised version of Krathwohl (Krathwohl, 2002). This heuristic divides learning processes into *remembering*, *understanding*, *applying*, *analyzing*, *evaluating*, and *creating*. This taxonomy has become well-known in higher education teaching methodology because a list of verbs is assigned to each learning stage, which can be used to formulate learning goals at the corresponding stage. (For critique, see Furst, 1981; Pring, 1971)

In the IDEN project, we have essentially been inspired by the postulate of Bloom's Taxonomy that levels should not be skipped. Learning at higher taxonomy levels cannot occur if there is no opportunity to go through the lower levels. This undoubtedly highlights the dilemma of a non-consecutive Master's program: on the one hand, learning must always start at the first taxonomy level since no common prior knowledge on the part of the learning group can be assumed, and on the other hand, the Master's level requires learning successes at the high and highest learning levels. This particular design makes

non-consecutive Master's programs structurally vulnerable in two ways. First, the dilemma can lead to a trivialization of the degree program if higher levels of learning are not sufficiently pursued. The second danger is when lower learning levels are skipped, learning at higher levels is demanded without sufficient preparation. The resulting learning design can lead to a recognizable loss of motivation. It might also happen that learning deficits at lower levels go unnoticed, and knowledge at higher levels is merely imitated. Especially in areas of knowledge close to everyday life, such as organizing or managing, discussions may be held with little analytical insight and, in the worst case, are limited entirely to the co-creation of truisms. Providing learning materials that systematically promote learning at the lower taxonomy levels and focusing on terms and theoretical concepts during the online phases could be one way to avoid the two dangers mentioned above. New theoretical terms and models can be used to gain new perspectives on practice if they have been understood in a sufficiently differentiated manner. This goal can be pursued online. The higher taxonomy levels must be stimulated, too, because otherwise new knowledge cannot be integrated into existing knowledge (Arnold & Schüssler, 2010). This goal can be pursued in the attendance phases.

5. The inner structure of an online unit

Given the learning circumstances of INEMA students, the online units are time-boxed. To facilitate student planning, the learning process is divided into sections, and the duration is known by the students in advance. For such a section, we set a learning time of 45 to 90 minutes and called it a *unit*. Of course, the scheduled times are approximates and will vary with the individual student. For the further fine structuring of the units, we used the principles of adult education (Knowles, 1980) and their implementation of what has been called the *Sandwich Teaching Strategy* (Feldmann, 2007) as a guideline. The actual learning stimulus is thus prepared by an introduction or pre-activation that allows learners to build on their prior knowledge. It is followed by a task that requires active engagement with the subject matter. Supplemented by information that serves as orientation in the learning process (naming the learning objectives, references to further literature, etc.), this results in a prototypical structure of an online unit (see Table 2). The different parts of a unit were called *chapters*, and each has a time duration that must be considered when calculating the total length of the unit. The time duration of a chapter

can range from one minute (e.g., for reading the learning objectives) to 40 minutes (e.g., for elaborating on the learning subject).

Table 2

Chapter of standard unit	**Description**	**Reason**	**Approximate time for processing**
1. Learning objectives for this unit	Approx. 1 to 5 objectives usually on the first two levels of Bloom's taxonomy	Transparency of the pedagogical structure to facilitate self-directed learning	1 min.
2. Introductory text (max. 150 characters)	A text that exemplifies the relevance of the topic	Facilitating learning by contextualizing, emotionalizing, or connecting to prior knowledge	1 min.
3. Overview of unit chapters	Table with links that lead to the chapters	Transparency of the pedagogical structure to facilitate self-directed learning	1 min.
4. Pre-activation or intermediate reflection (if a topic is extended over several units).	For example, Advanced Organizer, a test of prior knowledge, and a prompt for participants to describe their own experience with the topic	Establishing a link to prior knowledge. Opportunity to stimulate asynchronous discussions	10 to 20 min.
5. Learning object (e.g.: teaching input)	Presentation of new knowledge	Acquisition of new knowledge	15 to 40 min.
6. Learner activation	Active acquisition of knowledge through repetition, paraphrasing, or application	Acquisition of new knowledge, opportunity to stimulate asynchronous discussions	10 to 20 min

Chapter of standard unit	Description	Reason	Approximate time for processing
7. Summary and Outlook	Interim conclusion, reference to learning objectives, outlook on the following unit	Stimulating reflection on learning outcomes	1 min
8. Further resources	List of all sources mentioned in the unit and links to further resources	Possibility for consolidation of knowledge after the unit	1 min
9. Feedback	Possibility for immediate comment	Opportunity to stimulate asynchronous discussions and to improve the unit	5 min
Total			45 to 90 min

The detailed standard scheme aims to facilitate self-directed learning as efficiently as possible. It serves as a checklist, but not every chapter in every unit was implemented exactly according to this scheme. In some cases, the introductory text and the pre-activation (Chapters 2 and 4) were combined within an introductory video. It also happened that the teaching input was so complex that intermediate activations were inserted. As a result, chapters 5 and 6 were merged. In the case of deviations, the standard scheme helped to check whether the alternative solutions were equivalent to the original outline, and thus achieved the intended outcome just as well.

A second purpose of working with a standard scheme was to consider all time resources without overlooking any learning activities. Initially, we tended to consider only the three main chapters – pre-activation, learning object, and activation – when calculating time. This undermined our intention of timeboxing.

6. The design of the online learning materials

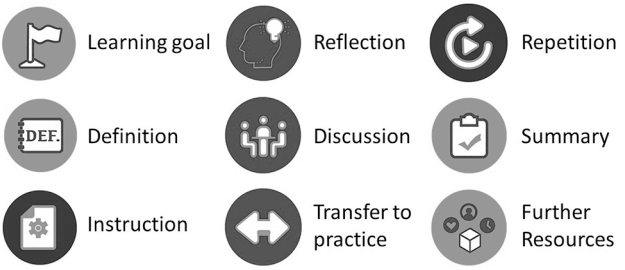
Oral presentations can play an important role in face-to-face classes, but online learning materials, in our experience, must rely primarily on written, au-

diovisual, or graphic presentations. This applies to all chapters of the standard unit, particularly to the presentation of the learning objective (i.e. the teaching input). Therefore, it was important to consider a graphic design that supports the learning process, or at least avoids any hurdles. It was essential that our learning material should facilitate ~~a~~ quick visual orientation, including ~~a~~ simple user guidance intended to prevent any feelings arising of being »lost in navigation«.

To ensure a clear structure, IDEN uses several design elements and specifications that are consistently applied to all units:

- Texts that appear directly in the unit – explanations of tasks, user notes, reader's guides or summaries – are kept short and do not exceed 100 words. Extended notes, e.g.~~,~~ notes used as learning objects or further resources, are visible as links or thumbnails to avoid »deserts of words«.
- Even short texts usually come with an icon, a graphic symbol indicating the character of the following text (an overview, a task, a summary, etc. See examples in illustration 1).
- All links open in a separate window to allow learners to return to the unit by simply closing the window. The only exceptions are links that navigate within the unit (chapter overview) or that lead to another unit if the preceding one has been completed.
- All graphic learning elements, such as animated videos, presentations, learning maps, etc., follow a style guide (see IDEN-Webpage, link in footnote 1) that defines the primary and secondary colors to be used. The color scheme is based on the corporate designs of the two involved universities.
- The layout of the units is vertical, i.e. progressing forward is achieved by scrolling down.

Illustration 1: Examples of icons illustrating the characteristics of text block following. (For all icons see download link in footnote[5]).



In addition to these general specifications, each unit follows an identical framework design:

Table 3

Design element	Description
Learning map	All units of a module are displayed as symbols on a learning map. Clicking on one of the symbols leads to the corresponding unit, whose chapters appear below the map. (The learning map is explained in more detail below.)
Unit title	Each unit has a meaningful title, indicating its learning content. The title is formatted as »Heading 1«.
Chapter	Each chapter has a meaningful title formatted as »Heading 2«. Besides the chapter headings, there are no other headings on this level.
Learning objectives and unit symbol	Each unit starts with a unit symbol, also found on the learning map (see below). The unit's goals are displayed by hovering the mouse over the symbol.
Introductory text	The short text is consistently given the heading »About this Unit« and preceded by the icon »Overview«.

5 https://www.ph-ludwigsburg.de/fakultaet-1/institut-fuer-bildungsmanagement/international-educational-leadership-and-management/iden-international-digital-education-network

Design element	Description
Tabular overview of the unit chapter	The tabular overview is located to the right of the introductory text against a slightly colored background.
Summary and Outlook	The text always bears the heading »Summary« and is introduced by the corresponding icon.
Further resources	This chapter is always titled »Further Resources« and is introduced by a »book« icon.
Feedback	This chapter is consistently headed »Your Comments«.

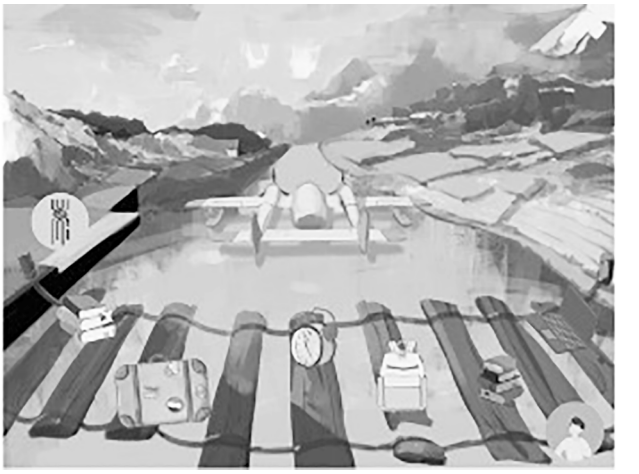
The design of the three main chapters (pre-activation, learning impulse, activation) is also based on the design specifications. However, the specifications are less schematic.

- All main chapters begin with a meaningful heading
- Icons can be used to illustrate texts (a total of 25 icons are available, see download link in footnote 1). However, if the chapter already contains a graphic element (e.g., a mind map that illustrates the structure of the subject matter in advance, or an embedded video whose preview image is visible in the unit), the icon can be omitted.

7. Learning maps

A learning map is the module's capstone and it summarizes the pedagogical and design considerations. The map is a picture (a photo or an illustration) representing the course's topic. A module on »Education Marketing« can be visualized by a marketplace, while the introductory course »Toolbox for Your Studies« depicts an airplane that needs to be loaded for the start of one's study trip (see graphic 2). In this background image, 20 symbols are placed, each symbol representing one of the 20 units of the course. The arrangement of the icons indicates the learning path, and the map is an advanced organizer that provides an overview of the course content. The map allows free navigation between units and encourages students to discover what is behind the symbols.

Illustration 2: The Learning Map. The objects on the bridge represent individual units, e.g. the alarm clock corresponds to the Time Management unit.



The symbols can be clicked on to access the corresponding unit, which appears below the map. Even while working on a unit, users continue to have access to the map by scrolling up to the top of the page. This visual navigation provides a clear structure even when additional optional units are added to the course. Furthermore, optional learning paths, including possible branches and side paths, can be easily visualized on the map. The learning map and the uniform design of the learning units thus jointly enable easy orientation and encourage explorative and self-directed learning.

8. The production steps of the online teaching materials

The descriptions mentioned above regarding the teaching materials' external form, length, learning level and the reference to the attendance phases, were indispensable for the shared understanding of the desired output. On this basis, we were able to define steps of a joint production process and set criteria for the intermediate results to be achieved. Of course, we were able to draw on concepts for the production process of online learning materials (Conole

& Oliver, 2007; Hoidn & Klemenčič, 2020). However, we found that we had to concretize and specify them considerably for our individual purposes.

1. The first step of our production process is a one-page outline of topics to be covered in the course. In addition, learning objectives for the course are formulated according to Bloom's Taxonomy. The objectives refer to a certain level of learning that students should have achieved before writing their academic paper (and which should enable them to do this). We formulated approximately three to five objectives per course. Instructors and course supervisors were responsible for this goal setting. At IDEN, we implemented this step through online meetings with lecturers from our partner universities, where together we created mind maps. Later, the learning objectives of the courses were discussed and further defined in weekly meetings.
2. The outline was followed by a rough planning of the attendance phase including the preparatory activities to be integrated into the upstream online phase (e.g., group assignments, presentations by the students, etc.). This planning was done by the lecturers of the course.
3. In a third step, the approximate list of essential literature to be presented in the online units was determined. Since the texts were to be made directly available to the students, copyright regulations had to be observed. In Germany, a maximum of 15% of a title may be copied and made available to a limited group for teaching purposes. Sometimes, additional book titles had to be considered to create a literature base that could be made fully available online. Student assistants could do the literature research, but the final decision was with the responsible lecturers.
4. The detailed planning of the online units was done with an Excel template that we created to support this step (see download link in footnote 1). This step aims (a) to define a learning path, i.e., an order in which the planned topics can be taught, (b) to name the individual units, (c) to define the learning objectives of the units, and (d) to assign the texts to the respective units. This planning was the responsibility of the lecturers of the course as well.
5. It has worked well for us to begin the construction of each unit with a summary of its textual basis. A well-written summary reflects the overall structure and content of the original text and sets a focus by paraphrasing and omitting passages. It is successful if it (a) does not distort the original text and (b) contains the information that will help achieve the unit's goals. The instructional designer for text production (TP) undertook this step. How-

ever, since their summary could lead to a shift in the unit's objectives, this was done in close consultation with the lecturers of the course.

6. Based on the text summary and the set learning objectives, the next step included a decision on the form of the learning object of the unit (Chapter 5 of the standard unit). Choices included presentations, film recordings, podcasts, HP5 graphics, screencasts, animated films and other options. The goal of this step was to provide an audiovisual presentation of the synopsis while offering some variety to the students. Depending on the choice, the text summary needed to be revised, shortened and adapted to fit the requirements of the chosen presentation medium. This was also a task for the specialist in text production.
7. The final creation of the learning object was done by members of the production team. Depending on its form, this was either completed by the specialist responsible for the learning platform (e.g., when creating a H5P graphic) or by the film specialist. Student assistants also contributed and, again, the creation process was supervised by the lecturers. It proved helpful to work with a web-based editing tool (e.g., Filestage), through which drafts could be shared with the entire group and in which editing requests could be easily documented.
8. In parallel with step 7, a decision about the form of activation (chapter 6 of the standard unit) had to be made. Choices included passing a multiple-choice test, creating a personal learning graphic, formulating a forum post, recording learning outcomes in a private learning journal, and other possibilities. This step was usually performed by the LPD.
9. Once the learning objective and the subsequent activation were defined, the preparatory activity (chapter 4 of the standard unit) could be developed. Personal learning objectives or prior experience with the topic could be enquired into. Review exercises were also an option to consolidate prior knowledge and prepare students for what followed. The technical implementation was done by the LPD.
10. In the final step, the learning objectives, introduction, overview, summary, resources, and feedback (Chapters 1 to 3 and 7 to 9) were created by the LPD and the introduction and outro (Chapters 2 and 7) were formulated by the instructional designer for text production (TP).

Through this sequence of steps, we produced teaching materials systematically and were able to locate difficulties in the production process. However, we are

far from the end of our learning process and are continually changing and improving our methods.

9. Conclusion

Experience to date shows that the production of online teaching materials is a time-consuming process, not only in the operative creation of the materials, but also in the collaborative sense-making process within the team of lecturers and instructional designers. It involves a constant risk of production steps having to be repeated to correct mistakes or approach topics from alternative angles. A misunderstanding between two people in the production chain can result in a doubled workload for some or all of the chain. For example, we encountered that, initially, the graphic designer interpreted educational scenes via imagery that was very reminiscent of primary and secondary schooling, rather than of higher education. The human figures portrayed were of different sizes and reinforced a clearly recognizable power difference between teachers and students. This did not align with our target group, and the misunderstanding only became clear after the first visualizations were already completed. It took extensive communication about the characteristics of the course and the target group to unify and synchronize our mental models. We had to develop a common language, and define exactly what we meant by each term, e.g. what a course, a unit, a chapter, or a map was, in order to be able to communicate our ideas with each other. It was also crucial to design the units from the foundation of a common text in order to be able to proceed with a division of labor at all. Here, it was of great benefit to have the new role of an instructional designer for text production, a role we had not yet thought of at the beginning of the project.

The specifications presented in this article regarding the language, function, design, and creation process of online materials has helped us to realize collaborative production. Nevertheless, the model presented here is certainly not the only way to develop teaching materials and there may be other ways to design instructional materials to support learning. The original intention of the project, i.e. to relieve lecturers of the production of teaching materials by establishing a production process based on the division of labor, was achieved. However, we had to realize that we had underestimated the extent of the necessary sense-making procedures in the team, that is, the shared understanding of *what* we were doing, *why* we were doing it, and for *which* problem we were

developing a solution. As a result, a production process was created that relieved the lecturers and further enriched the students.

Online courses are, in all their parts, steps in a mediation and translation process that begin with the text basis and reach a preliminary end with the student's creation of their scientific paper. Each intermediate step – the objectives, the summary, the learning object, the activation, etc. – can be understood as an »immutable mobile« (Latour, 2003), that is, as an artifact with its own meaning, that transforms the connotation of the previous step and prepares for the link in the chain that follows. Thus, the production of online learning materials emerges as a chain of sense-making and sense-transforming processes.

What has been postulated several times for e-learning, in general, seems to be confirmed for the creation of online teaching materials: e-learning follows the same rules as regular face-to-face teaching and has no specific e-learning pedagogy (Arnold, 2006). However, pedagogical principles need much more attention, as carelessness can more easily lead to student dropouts and a loss of retention. Exploring the challenges of designing technology-enhanced, asynchronous learning processes therefore offers an excellent opportunity to understand more precisely what we do in teaching.

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