Chapter

Navigating the Landscape of Blended Higher Education: Didactical Design Principles for Students' Broad Development

Hanneke Theelen, Milou De Smet, Dave Van Breukelen, Laura Eeckhoudt, Dinska Van Gucht, Karolien Adriaens and Claudio Vanhees

Abstract

In recent years, blended teaching formats have become increasingly important in higher education. Designing effective blended education is challenging and requires a profound knowledge of digital tools and technologies, as well as the didactical proficiency to deploy them effectively and efficiently within the learning environment. However, little is known about didactical design principles to support teachers in creating an effective blended design. This chapter reports on the combined results of two independently conducted extensive literature reviews that investigated (a) didactical strategies, methods, and techniques concerning online education in the existing empirical research on higher education, and (b) the effects of different blended teaching formats, compared to face-to-face education, on learning outcomes and/or psychosocial outcomes in higher education students. It was found that blended education can enhance student achievement and psychosocial well-being, yet that the instructional approach plays a crucial role. Combining the insights of both studies has subsequently led to a series of evidence-informed recommendations to design effective blended education with a view to the broad development of students. Readers will be provided with practical guidance on how to implement these design principles in educational practice.

Keywords: blended education, didactics, instruction, design principles, achievement, psychosocial well-being, higher education

1. Introduction

In recent decades, technology has claimed an increasingly prominent role in education. This encompasses the use of hardware (e.g., computers, tablets, interactive whiteboards), e-learning platforms, educational software, online learning resources, and a variety of communication tools for both teachers and students. The COVID-19

pandemic further sped up this process by forcing many educational institutions to abruptly shift from (mainly) face-to-face to fully online distance education (Emergency Remote Teaching (ERT); [1]). Within this spectrum, blended education (see *theoretical background* for detailed definitions) can provide opportunities to make education more flexible and enrich the curriculum in an engaging manner [2]. Simulations, for instance, can visualize "invisible" phenomena such as electricity, or the use of virtual reality can mimic real-life situations. At first glance, this opens up numerous possibilities for interactive and activating learning. On the other hand, due to its inherent nature, ERT was often not based on a deliberate didactical design. Also, it negatively affected students' psychosocial well-being as it increased feelings of isolation and anxiety [3], and consequently underlined the need to strive for a well-thought balance in blended higher education design. It is therefore important to consider how blended education should be effectively designed, not solely in terms of combining face-to-face (FTF) and online learning activities, but equally in promoting both student achievement and psychosocial well-being.

Current research that systematically examined and compared blended education with FTF formats has revealed slightly positive effects of various blended formats on outcomes in students (e.g., [4]). Most studies, however, focus almost exclusively on the effect on academic achievement (i.e., knowledge and skills), while psychosocial outcomes (e.g., well-being, metacognition, and personal growth) are rather understudied, and limited to specific blended teaching formats (e.g., [5]). Moreover, often the effect of specific digital tools or learning environments is examined (tool-oriented), with limited attention to didactical design, that is, how those tools are used to promote effective learning (goal-oriented). Given that blended education is now likely to become a permanent and increasingly important facet of higher education, it is essential to understand how teachers can design blended education that effectively promotes both student achievement and psychosocial well-being. In order to fill this gap in the literature, this chapter describes evidence-informed didactical design principles for effective blended higher education, with a focus on students' broad development, by combining the insights of two independently conducted literature reviews.

2. Theoretical background

2.1 Online and blended education

Firstly, we delineate the terms "online education" and "blended education," and describe where specific blended teaching formats such as the flipped classroom are situated within this continuum.

Figure 1 illustrates the extent to which technology, including the use of digital tools, can be applied in education, and where various teaching formats can be positioned on this continuum [6, 7]. At the far left of the figure, face-to-face education is found, in which no technology is used. The next three teaching formats can be positioned under the umbrella term "online education," as it entails the use of technology to replace or supplement face-to-face education [7], namely (1) face-to-face education supported by technology; (2) blended education; and (3) fully online distance education. In this chapter, we are primarily concerned with the use of technology in education, and we will therefore subsequently discuss the three latter types in more detail below the figure.

Figure 1.
Online education and the level of technology.

1. *ICT in support of face-to-face education*: face-to-face education with (minimal) technological support in order to enrich or support lessons. For instance, the use of digital presentations to present course materials, digital interactive quizzes to assess (prior) knowledge, or even the use of simulations to teach students about electricity [6]. There are no elements of distance education, and all activities take place in face-to-face settings.

2. *Blended education: face-to-face and online combined*: blended education is often described as a deliberate and integrated combination of face-to-face and distance education [8]. Within this definition, it is important to underline the terms "deliberate" and "integrated," as blended education goes beyond simply merging face-to-face and distance education, and equally implies more than simply adding distance components to traditional face-to-face education. It involves a thoughtful combination, or blend, of both approaches [9].

One of the most extensively studied blended teaching formats is the flipped classroom (e.g., [10–12]), in which students independently review the (often theoretical) learning materials before the lessons, for example, by completing a learning path in the digital learning environment or studying knowledge clips. **Figure 2** illustrates how during the lessons, ample time can then be dedicated to actively processing the studied learning materials, for instance, through relevant case studies, assignments, group work, discussions, or quizzes. While actively processing and practicing the course materials in class, students can rely on instruction and support from the teacher and equally have sufficient time and space for interaction among peers. After class, there is once again time and space for independent practice and application of the covered course content.

3. *Fully online distance education*: The most extensive form of online education is fully online distance education, in which teachers offer the learning materials entirely remotely, and primarily with the use of the internet [13]. The so-called massive open online courses (MOOCs) are a well-known example [14, 15]. This type of education does not involve any face-to-face components that are organized at a specific educational location. Although distance education can also be organized without the use of technology (e.g., sending textbooks and courses by regular mail), it is increasingly becoming technology-supported.

In what follows, this chapter focuses on blended education, as it encompasses widely used and versatile teaching formats that thoughtfully and deliberately combine face-to-face and online learning, which can be organized both synchronously and/or asynchronously.

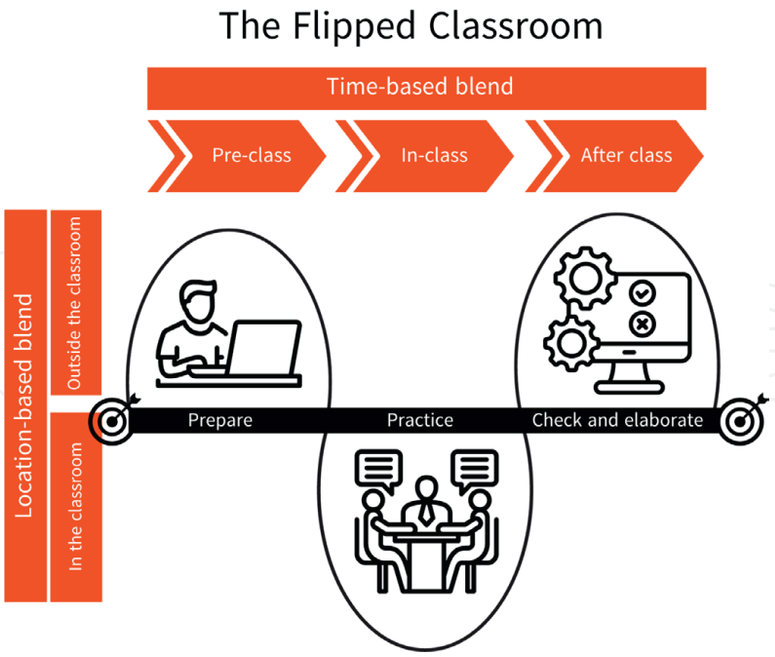

Figure 2.
Schematic overview of the flipped classroom.

2.2 Blended education and (a)synchronicity

Synchronous interactions involve live contact with students and can occur during face-to-face moments in the classroom, but also online (e.g., a live online lecture). During synchronous interactions, (prior studied) theoretical content can be further explained, deepened, and practiced. Synchronous interactions can also facilitate community-building among students, which could lead to increased involvement [16].

Asynchronous interactions, on the other hand, do not occur chronologically and are particularly important to facilitate instances in the learning process when live interaction between teachers and students, or among students themselves, is not required [16]. Asynchronous interactions can be used by students to process course materials independently and within established boundaries, at their own pace. In this manner, instructional videos, digital simulations, or digital learning paths can ideally be studied more than once to optimize retention [17]. Moreover, on discussion boards, asynchronous interactions can provide students with more time to formulate a suitable response, which could encourage students to deeply engage with the course content before answering [16].

Blended education allows to deliberately combine both types of interaction. When students have already independently studied the course content beforehand (asynchronously), teachers can subsequently use synchronous interactions to work on aspects that students may struggle with, discuss specific assignments, or apply acquired knowledge in practical scenarios. In this manner, teachers can decide to use synchronous interactions less for pure knowledge transfer but reserve them primarily for learning activities that focus more on the application of the acquired knowledge.

2.3 Blended education and broad development

The broad development of students encompasses both the enhancement of learning outcomes (i.e., knowledge and skills) and psychosocial outcomes (i.e., well-being,

DOI: http://dx.doi.org/10.5772/intechopen.114154

metacognition, and personal growth). The Taxonomy of Significant Learning [18], as shown in **Figures 3** and **4** illustrate how both aspects are of great importance for student development. It delineates six dimensions that contribute to meaningful learning.

With regard to *learning outcomes* (see **Figure 3**), we focus on three dimensions of the taxonomy, namely (1) the acquisition of foundational knowledge, (2) its application, and (3) its integration [18]. It is crucial for students to first build a solid knowledge base, and to be able to retain and comprehend it, which then serves as an essential foundation to thoughtfully perform practical tasks [19, 20]. In addition to acquiring the necessary knowledge about the course content, its subsequent application in skills is also an important learning goal. The objective is for students to become proficient in specific tasks, such as conducting lab experiments, removing stitches, administering physiotherapeutic treatments, or improving communication skills.

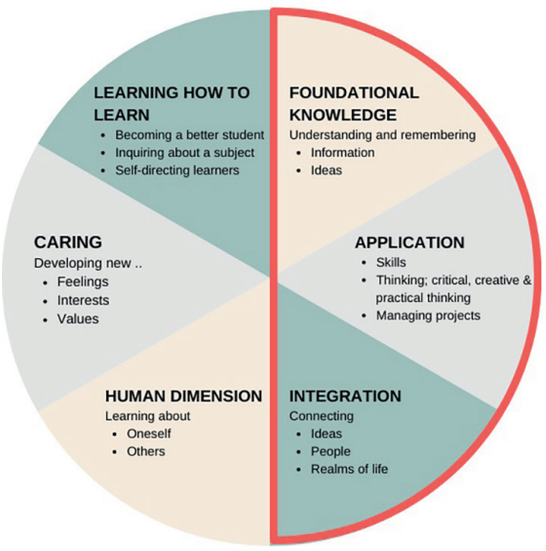

Figure 3.
Learning outcomes in Fink [18].

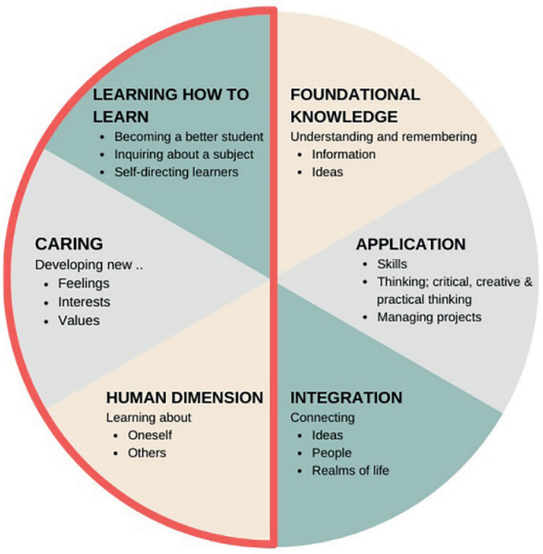

Figure 4.
Psychosocial outcomes in Fink [18].

However, it is not always possible nor desirable to distinguish between knowledge and skills thereby strictly. In-depth domain knowledge serves as the indispensable foundation for skill development and application [21]. Besides learning outcomes, Fink [18] also addresses (4) the human dimension (intra- and interpersonal perspectives), (5) caring (feelings, interests, and values), and (6) learning to learn (metacognition), thus advocating a holistic approach to education (see **Figure 4**). These aspects are referred to as psychosocial outcomes in this chapter.

To gain a better understanding of how blended education can be optimally designed from a didactical perspective with a view to enhance students' broad development (i.e., both in terms of achievement and psychosocial well-being), this chapter describes the results of two literature reviews that were carried out independently, yet with similar and compatible inquiries. In the following section, the research methods of both studies will be elaborated. Although both literature reviews were performed in a different context and used their own approaches, similar results and recommendations emerged from both studies. Combining the results of both review studies in this chapter underlines the scientific support and power, but also the generalizability of the results found.

Review study A was conducted by authors HT and DVB based on the following research question:

- What is known about didactic and pedagogical strategies, methods, and techniques concerning online education in the field of empirical research on higher education?

Review study B was carried out by authors CV, MDS, LE, KA, and DVG to answer the following research questions:

- What are the effects of different blended teaching formats, compared to face-to-face teaching, on learning outcomes and/or psychosocial outcomes in higher education students?

- What didactic preconditions do effective blended teaching formats (i.e., with positive effects on student learning outcomes and/or psychosocial outcomes) adhere to?

We first outline the distinct methodologies employed in both review studies. Subsequently, we provide an overview of the evidence-informed recommendations for an effective blended design distilled from these reviews in the results section, followed by general suggestions for the design process in the discussion and conclusion section.

3. Methodology

3.1 Search process

3.1.1 Study A

To address the research question, we conducted a thorough examination of existing literature through a systematic literature review. We utilized databases Scopus, PsychINFO, and Education Resources Information Center (ERIC) to identify studies meeting specific inclusion criteria: (1) articles written in English, (2) peer-reviewed

Keywords	Synonyms
e-learning	"Online education", "distance education", "online learning", "online program", "online course", "online schooling", "online training", "blended learning", "hybrid learning", "hybrid education", "online teaching"
Didactic* / pedagog*	"Method", "instruc*", "inform*", "activit*", "model*", explain*", "strateg*", "tactic*", "approach*", "design*", "program*", "course*", "technique*", "tool*", "intervention*", "technolog*", "teach*", "school*", "train*", "prepar*", "coach*", "tutor*", "educat*"
Higher education	"Universit*", "academic"

**Variations of the keyword, such as plurals, were also included as search terms.*

Table 1.
Search query of study A.

articles, (3) studies employing qualitative, quantitative, or mixed-method approaches, (4) articles focusing on online education, didactics or pedagogy, and higher education or related terms. The keywords as described in **Table 1** were derived from relevant literature related to the didactics and pedagogy of online education, also denominated "e-learning," within higher education.

3.1.2 Study B

To gain more insight into the effectiveness of blended teaching formats on both learning and psychosocial outcomes in higher education, a rapid evidence assessment (REA) of existing systematic review studies (SR) and meta-analyses (MA) was conducted according to PRISMA guidelines [22]. The initial search was conducted in the Education Resources Information Center (ERIC) and Web of Science (WoS) databases, with the following inclusion criteria developed according to the PICOS framework: (1) higher education students (Population); (2) implementations of a blended teaching format at course level (Intervention); (3) compared to a face-to-face teaching format (Comparison group); (4) learning outcomes and psychosocial outcomes in students (Outcomes of Interest); (5) peer-reviewed systematic reviews and/or meta-analyses written in English (Study design). The keywords used in the search query are described in **Table 2**.

Keywords	Synonyms
Blend* learning	"Flipped blend", "hybrid learning", "supplemental blend", "flipped learning", "replacement blend", "online learning", "technology mediated learning", "blend* course", "technology enhanced learning", "hybrid course*", "technology transmitted learning", "flipped course*", "digital learning", "online course*", "e-learning", "flipped classroom", "multimedia learning", "inverted classroom"
Higher education	"University", "college*", "undergraduate*", "bachelor degree", "polytechnic"
Achievement	"Learning", "skill*", "development", "knowledge", "attitude*", "well-being", "personal*", "social*"
Meta-anal*	"Review"

**Variations of the keyword, such as plurals, were also included as search terms.*

Table 2.
Search query of study B.

Both review studies focused on the period from 2010 to 2021, as the surge of the Internet in the 1990s to 2000s significantly impacted the integration of online technologies in educational settings [23, 24]. Between 2000 and 2010, there was a notable rise in initiatives related to online education, resulting in a substantial increase in student participation. By approximately 2007–2010, online education had become an integral part of educational practice [2, 13].

3.2 Selecting articles

3.2.1 Study A

The process of selecting articles for this systematic literature review is outlined in **Figure 5**. A total of 1040 studies were identified in Scopus, 837 in ERIC, and 356 in PsychINFO. Among these, 376 studies were duplicates. The two authors (HT and DVB) jointly reviewed 100 abstracts to ensure consistent application of the inclusion criteria. The remaining abstracts were divided between the two authors. Following this initial screening, 1739 studies were deemed unrelated to the topic. Approximately 1340 studies did not address the pedagogy or didactics of online education. Many studies primarily focused on student experiences and learning outcomes in (partially) online learning environments or were centered on the procedural aspects of design rather than on the design itself.

An additional 193 studies were excluded as they did not pertain to online education, while 115 studies did not pertain to higher education. Furthermore, 91 studies were excluded for various other reasons, such as discussing the management, organization, or financial aspects of a (partially) online course, detailing the technical design of a tool rather than the pedagogical use of it, or addressing a (blended) combination of institute-based education and internships. For the remaining 118 articles, both authors jointly reviewed the full texts to definitively determine which articles met the criteria for inclusion in the literature review. After a thorough discussion, 42 articles were identified as suitable for inclusion.

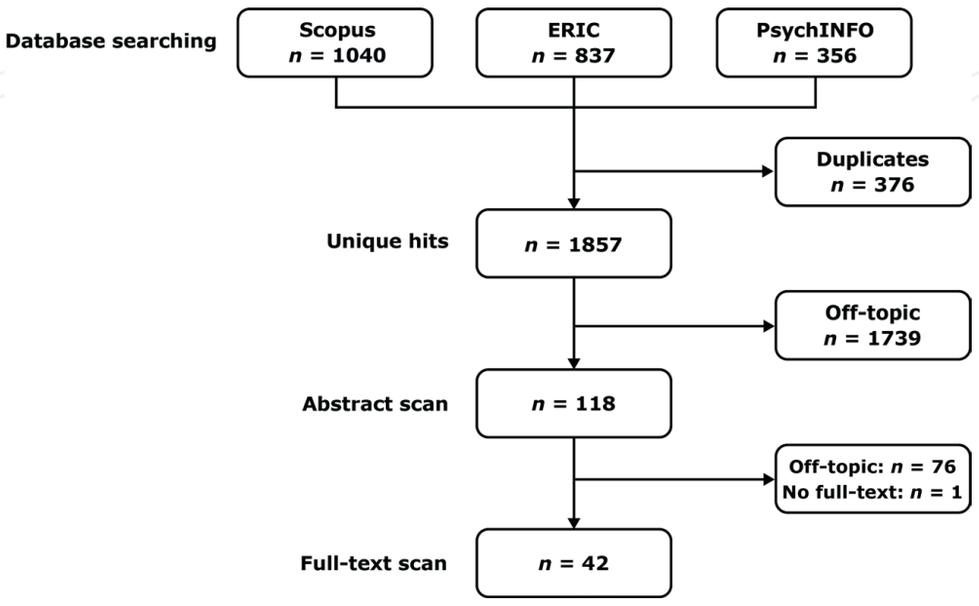

Figure 5.
Selection process of study A.

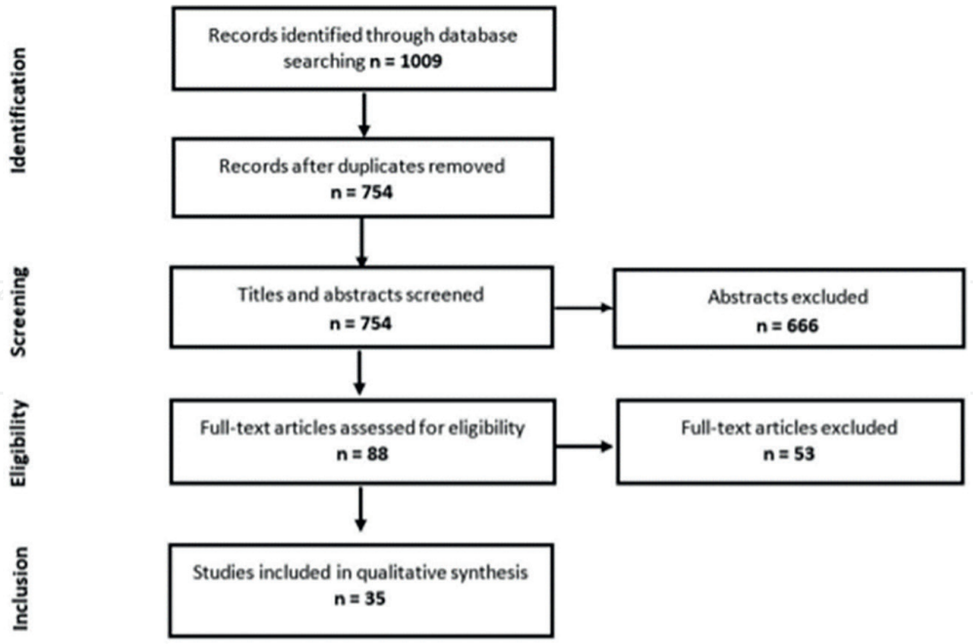

Figure 6.
Selection process of study B.

3.2.2 Study B

The screening procedure as shown in **Figure 6**, the subsequent critical appraisal of the review studies, as well as the data extraction and processing were carried out by five independent expert reviewers (authors CV, MDS, LE, KA, DVG). In total, 1009 systematic reviews and meta-analyses were identified in Web of Science and ERIC, of which 255 studies were duplicates. The 754 titles and abstracts of the resulting studies were independently reviewed to ensure consistent application of the inclusion criteria. Following this initial screening, 666 SR and MA were deemed unrelated to the topic. The remaining 88 review studies were read in full, resulting in 42 studies that met the inclusion criteria. These 42 SR and MA were then subjected to a thorough and independent critical appraisal (CA) by a minimum of two authors in order to determine the methodological quality. The studies were scored on four domains, namely (1) study eligibility criteria; (2) identification and selection of studies; (3) data collection and study appraisal; (4) synthesis and findings and based on the total score labeled as (a) high-quality; (b) average-quality; and (c) low-quality. The detailed CA-instrument is available upon request. Discrepancies were discussed and resolved by consensus. Seven additional SR and MA of low methodological quality were subsequently excluded. Therefore, in total, 53 full-text studies were excluded in the eligibility phase, resulting in 35 high-quality meta-analyses and systematic reviews for further analysis.

3.3 Analysis.

3.3.1 Study A

First, the 42 included studies underwent categorization using the following coding scheme:

1. General information: this included details like authors, title, publication year, database source, journal, abstract, country, and field.

2. Research design: this encompassed the research type (quantitative, qualitative, or mixed-method), data collection methods, and participant count.

3. Type of e-learning: this identified whether it was blended or distance learning, including the authors' provided definitions and components.

4. Design principles: this covered learning theories, didactic principles, pedagogy, and recommended practices.

These categories helped uncover both similarities and differences among the studies. Notably, this review specifically focused on online education. Next, labels were derived through open coding of the design principles, involving a continuous comparison of similarities in the data. Two key continua emerged as pivotal for e-learning: the active learning continuum and the authentic learning continuum. Finally, axial coding established connections between the labels from the open coding. To ensure inter-rater reliability, both authors collaborated closely throughout the analysis process until consensus was achieved.

3.3.2 Study B

The 35 retained meta-analyses and systematic reviews were first independently analyzed by at least two members of the research team by means of a review matrix with the following elements:

1. General information: APA reference, domain, research question(s), SR and/or MA; critical appraisal score;

2. Included source studies: range of source studies; n studies on BL compared to FTF/total N included studies;

3. Type of blended education: provided definitions and components, and position on the MIX-taxonomy [25];

4. Outcome variables: learning outcomes and/or psychosocial outcomes (including terms, provided definitions, and measurement instruments);

5. Effects: positive and/or negative effects on learning and/or psychosocial outcomes in students, including effect sizes if provided;

6. Didactic preconditions: how, when, and why do positive and/or negative effects occur (including moderator analyses in MA if provided); link with learning theories, and instructional design;

7. Overall conclusions: is blended education effective as compared to FTF teaching formats, and if so where, when, and how?

Discrepancies were discussed by the complete research team and resolved by consensus. Subsequently, two sub-teams of reviewers further analyzed the effects on learning outcomes (authors CV, MDS, and LE), and psychosocial outcomes (authors KA and DVG) respectively. The findings were then presented and discussed between both sub-teams and finally combined into a qualitative synthesis.

4. Results: recommendations for an effective blended design

Based on both literature reviews, it was found that blended education formats potentially enhance students' learning outcomes and their psychosocial outcomes. However, not all studies showed positive effects. Some studies did not show any difference between blended and face-to-face education, and a minority even showed negative effects of blended education compared to face-to-face education. Blended teaching formats therefore do not always or automatically lead to enhanced outcomes. We consequently delved deeper into the characteristics of moderators in meta-analyses, and the characteristics of individual source studies to understand the underlying didactic preconditions; what works, when and why? This analysis revealed that the instructional approach plays a crucial role. Hence, instructional recommendations were distilled, which are presented below.

The combined results of both literature reviews have led to a series of evidence-informed recommendations for the effective design of blended education with a view to promoting student achievement and psychosocial well-being. **Figure 7** provides an overview of the recommendations discussed in this chapter, which can be categorized into prerequisites, and four didactical themes: (1) authentic learning, (2) content and process scaffolding, (3) peer-to-peer learning, and (4) formative strategies. All these

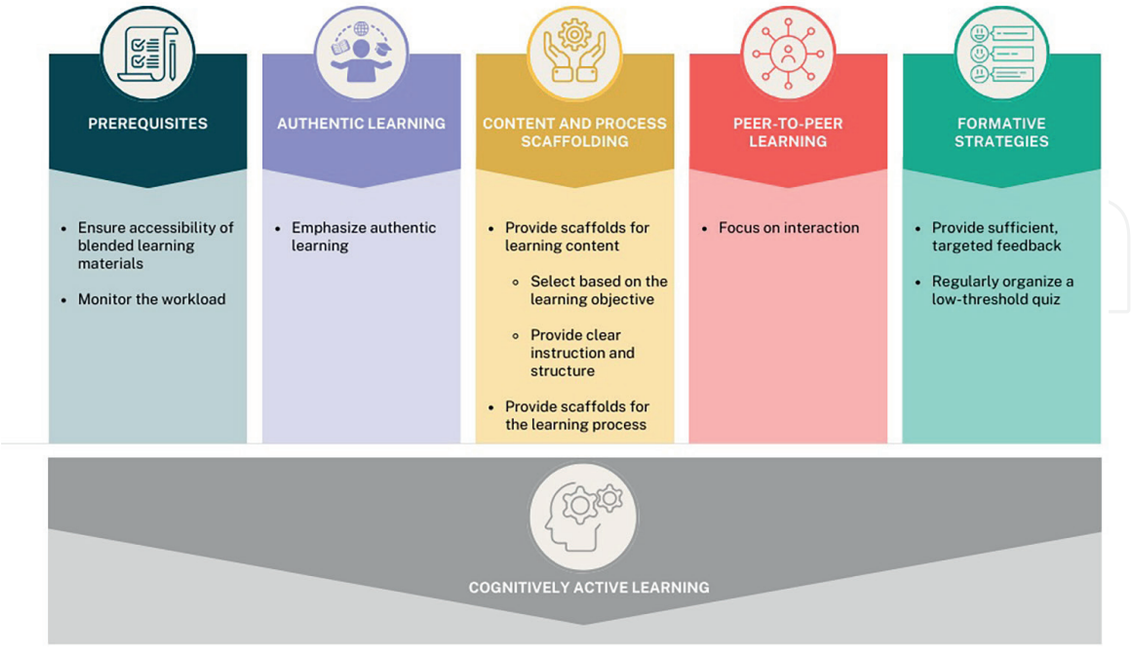

Figure 7.
Overview of recommendations for an effective blended design.

recommendations contribute to the cognitive activation of students, which was found to be a crucial overarching element for an effective blended design. In the following sections, we will discuss each component of **Figure 7** in detail.

4.1 Cognitively active learning

Active learning plays a significant role in all effective teaching formats, but particularly in a blended design. This implies that in an effective blend, students should be encouraged to actively engage with course content on a cognitive level. Cognitively active students do not only appear to be actively engaged in various activities at first glance but are sufficiently challenged to deeply reflect on the course content, thereby gaining lasting learning experiences [26]. This can be achieved by integrating the four didactical recommendations which we will discuss below. However, several prerequisites of an organizational nature should be met before teachers can start to design an effective blend based on the didactical recommendations.

4.2 Prerequisites

Two concrete examples of organizational prerequisites emerged from the review studies, namely accessibility and workload.

4.2.1 Ensure accessibility of blended learning materials

First, teachers should verify whether their course is sufficiently accessible for all students. This implies, for instance, a stable internet connection at home, the required hardware and software, and the appropriate knowledge and skills (such as ICT skills) to effectively engage with the technological aspects of a blended course. If not, teachers ought to direct students to the appropriate facilities where they can receive assistance in acquiring the necessary hardware and software. Moreover, they could assist them in developing the necessary knowledge and skills to use digital learning materials for a blended course.

4.2.2 Monitor the workload

Additionally, when designing blended education, it is important to closely monitor students' overall workload. Ensure that teachers (design teams) design, integrate, and replace components thoughtfully, rather than simply adding digital or blended components to the existing course design. This prevents the total workload of the course from being exceeded quickly.

4.3 Emphasize authentic learning

The use of technology provides opportunities for teachers to create (more) authentic learning experiences. The learning process encompasses materials and situations that range from non-authentic to highly authentic [27]. On one end of the spectrum, there are learning materials that offer little to no context, such as simple arithmetic problems or multiplication tables, which are of course important as a solid basis for subsequently acquiring more advanced content. On the other end, learning materials are closely tied to practical applications, such as the use of simulated learning environments or real-life scenarios. Simulated learning environments give teachers the opportunity to replicate

workplace scenarios in a lifelike or authentic manner, resulting in rich learning experiences [28]. Consider, for instance, midwifery students practicing episiotomies in a virtual reality environment, or facility management students conducting building visits and inspections through a 360-degree photo tour. Once they have acquired a solid basis of foundational knowledge, students can then experience situations that closely resemble what they will encounter in their future workplaces. If these real-life situations present complex problems that students must solve, they can be used to enhance their understanding and the relevance of the subject matter. Additionally, they can help bridge the gap between theoretical knowledge and practical application as students witness how the concepts, they learned in the classroom are actually applied in professional environments. If used purposefully and thoughtfully, technology can play a significant role in this process.

4.4 Content and process scaffolding

Effective blended education places a strong emphasis on scaffolding. In education, scaffolding refers to the supportive structure and guidance provided by a teacher to assist students in understanding and mastering new concepts or skills [29]. This support is tailored to the needs of students and is gradually phased out as students gain more independence [30]. This serves to prevent cognitive overload [31, 32] in students (for instance, due to excessive information, stress, or overly high complexity), and supports the gradual development of self-regulatory skills [33]. The goal of scaffolding is to assist students in achieving a higher level of understanding and performance [34], and it is crucial in two domains: delivering the course content and supporting the learning process.

4.4.1 Content scaffolding

Teachers should ensure that the course content follows a clear learning trajectory and is presented to students in manageable segments. By providing sufficient structure and support, teachers can assist their students in achieving the learning objectives. In this regard, two important recommendations can be outlined: selection of an appropriate blend based on the learning objectives and the provision of clear instruction and structure.

4.4.1.1 Select based on the learning objectives

It is crucial to first determine the specific learning objectives, and then decide which course content and teaching methods align with it. What do students need to know and/or be able to do? In that regard, blended education should not be considered a goal in itself, but merely a means to achieve the learning objectives. It is important to ensure that the blended design is purpose-driven rather than tool-driven. For instance, for teachers who primarily aim to enhance specific applied skills of students, a flipped classroom can be a highly effective blended teaching format (e.g., [11, 12]). Students can independently and asynchronously study theoretical contents at their own pace, and subsequently apply and integrate the underlying theory to practice domain-specific skills in the synchronous component (face-to-face or online).

4.4.1.2 Provide clear instruction and structure

Clear communication about the content and format of a course is essential. Students need a clear and well-defined overview of the learning objectives to be

achieved, what the lesson structure and course layout entail, and how the objectives and content are interconnected. This can be achieved, for example, through the use of an advanced organizer [35] or a schedule that structures the course of the lessons and clarifies the relationship between different lessons, content, and activities.

4.4.2 Process scaffolding

Besides scaffolds in terms of course content, teachers can also offer students support in organizing the learning process. In many blended teaching formats, a high degree of self-regulation [33] is expected of students, particularly in the asynchronous components. However, most students often have insufficient mastery of the required self-regulatory competencies. It is therefore essential for teachers to guide and support students in developing self-regulatory study skills, such as planning, applying effective learning strategies, and monitoring their study progress. Students need to learn to consciously reflect on their learning objectives, the most effective and efficient learning strategies, and how to assess and adjust their own learning process to effectively utilize the available time for preparatory activities. This leads to improved preparation and satisfaction among students [36].

An effective way to support this process as a teacher is through (metacognitive) scaffolding [30, 37]. Initially, a high level of support can be provided by the teacher, tailored to the students' level. This can be achieved, for example, by explicitly discussing effective learning strategies, initially modeling these strategies, collaboratively working on exercises, providing feedback, providing instruction, etc. In that manner, students have the opportunity to adjust their learning process and gradually develop self-regulatory study skills. As students become more proficient, teachers should gradually reduce the support so that students can ultimately employ self-regulating (effective study) strategies independently.

4.5 Peer-to-peer learning

An interactive and collaborative component in blended education has a positive effect on both learning outcomes and psychosocial outcomes. By emphasizing collaborative learning [38], students can learn from and with each other without constant involvement from the teacher. In a blended learning environment, teachers can organize these interactions synchronously, both face-to-face in the classroom and online through for instance, webinars, chat sessions, or live peer discussions. These synchronous forms of interaction can make students feel more connected [16]. Furthermore, through discussions in synchronous interaction, greater depth can be achieved. This, in turn, can contribute to higher engagement and a more active attitude, thereby increasing student motivation and satisfaction. In addition, teachers could also employ asynchronous interactions by means of wikis or forum discussions. These forms of interaction provide students with ample time to formulate responses or answers, and with sufficient guidance, can facilitate the development of self-regulatory (study) skills.

4.6 Formative strategies

A final recommendation outlined in this chapter is the regular use of formative strategies [39]. These are actions that provide teachers with ongoing insight into the performance and progress of students. This helps teachers (and their students) to

make decisions about the next steps in the learning process. Two effective formative actions that surged from the review studies are (1) providing sufficient, targeted feedback, and (2) regularly organizing low-threshold quizzes.

4.6.1 Provide sufficient, targeted feedback

Ensure the provision of sufficient, process-oriented feedback that prompts students to think and act [40]. It is important to offer students' knowledge-developing feedback: clear quality requirements so that students know what is expected of them (feed up), followed by feedback on where the students are situated in the learning process (feedback), and concrete tools they can use independently to improve their performance (feed forward). It is crucial to provide targeted feedback early on in the learning process, as this guides students in their learning and allows them the opportunity to adjust their learning process. This, once again, leads to the enhancement of self-regulatory skills [33]. The use of digital learning environments can enable instructors to monitor individual activities and study the progress of students easily and comprehensively, allowing the provision of timely and targeted feedback.

4.6.2 Regularly organize a low-threshold quiz

By using a short and low-threshold quiz, teachers can review or test the contents that students have already studied. When organized at the beginning of a lesson, important prior knowledge is activated in students, which they need to connect new information from the lesson [20]. Additionally, the answers and scores of students on such quizzes provide teachers with the opportunity to assess whether their students have understood and retained the material and identify any gaps or misunderstandings. This allows them to adjust their lessons accordingly.

Regularly using quizzes and similar activities at the start of the lesson positively influences students' learning outcomes and is considered an effective learning strategy. When students practice actively retrieving learning material from their memory (retrieval practice; [41]), they strengthen their memory more compared to so-called passive learning strategies, such as rereading materials [42]. In other words, it helps students to retain information better, and for a longer period of time. It is important however, to alternate with different learning activities that facilitate retrieval practice, for instance, a one-minute paper [43] or think-pair-share, as starting each lesson with a similar quiz type is not very motivating for students in the long run.

5. From recommendations to an effective blended design

Instructional recommendations do not automatically lead to an effective design. So how can the aforementioned recommendations be translated into an actual blended design? There is no fixed format for designing blended education, but it is recommended to design from back to front: backward design [44]. **Figure 8** illustrates how the desired learning objectives are first identified: What needs to be learned and by whom? Then, it is determined what the learning process will look like, and how progress can be made visible and monitored. Finally, a logical structure and sequence are established, and suitable learning tasks are planned, selected, and designed. Only then the specific online or offline learning resources (tools) are selected. In other words, the design starts from the learning objectives, and ends with suitable tools,

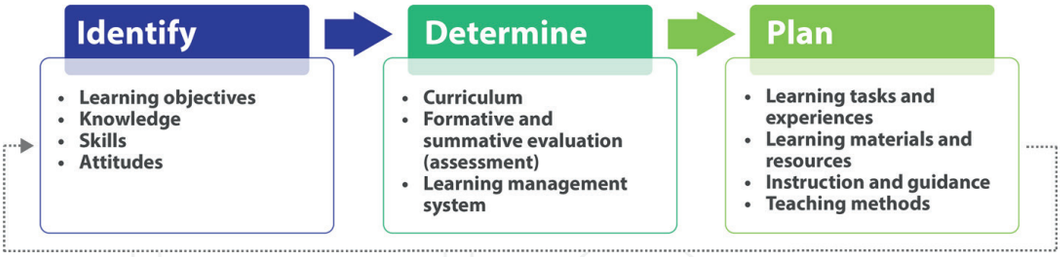

Figure 8.
Backward design.

and not vice versa. The design principles described in this chapter are particularly important for the second and third design phases.

In terms of practical organization, it is recommended to assemble an interdisciplinary design team [45]. In such teams, various roles are represented: teachers, information and communication technologists, educationalists, and policymakers. Another valuable suggestion is to initiate each design phase described above with a brainstorming session. A whiteboard or flipchart can then be used to record and connect essential elements. The aim is to progressively introduce more structure into the process. Students can also be actively engaged in the design process, particularly during the final evaluation and potential redesign, so that their perceptions and experiences can be taken into consideration. A final recommendation is to stick to the essence and to resist the urge to implement every design suggestion. The learning objectives are central to the design, so the next design phases should always consider what is necessary to achieve them.

6. Conclusion

In summary, the exploration of two different literature reviews in this book chapter has shed light on relevant design principles essential to the development of blended education. Despite methodological variations and a slightly different focus in the literature studies discussed, a fundamental similarity emerged. The synthesis of findings highlighted two important prerequisites for effective design: ensuring the accessibility of blended learning materials and monitoring the workload. These prerequisites were complemented by recommendations within four main themes: (1) emphasizing authentic learning, (2) content and process scaffolding, (3) leveraging peer-to-peer learning, and (4) implementing formative strategies. While these recommendations resonate with established principles in traditional face-to-face education, their increased significance in the realm of blended education, particularly within student-centered contexts, underscores their additional relevance. This synthesis of two literature reviews underlines the essence of adapting established didactical principles to blended education and highlights their essential role in shaping effective teaching.

*Included in review study A; **included in review study B

Navigating the Landscape of Blended Higher Education: Didactical Design Principles
DOI: http://dx.doi.org/10.5772/intechopen.114154

Author details

Hanneke Theelen[1*], Milou De Smet[2], Dave Van Breukelen[3], Laura Eeckhoudt[4], Dinska Van Gucht[4], Karolien Adriaens[4] and Claudio Vanhees[2]

1 Zuyd University of Applied Sciences, The Netherlands

2 Centre of Expertise Education and Learning, Thomas More University of Applied Sciences, Belgium

3 Fontys University of Applied Sciences, The Netherlands

4 Centre of Expertise Care and Well-being, Thomas More University of Applied Sciences, Belgium

*Address all correspondence to: hanneke.theelen@zuyd.nl

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