

# **Use of Blended Learning and Blended Networking in Adult Education in the Fields of Study Photogrammetry and Mobile Mapping**

**Valentin WICH, Jürgen SELENSKI, Ansgar BRUNN, Germany**

**Keywords:** Blended Learning, Blended Networking, Photogrammetry, Mobile Mapping

## **SUMMARY**

State of the art adult education combines both online and offline lectures. There is a variety of terms that describe combinations of online and offline learning settings.

We apply Blended Learning in the project SMART vhb to teach students photogrammetry, laser scanning and image analysis. We extend Blended Learning by face-to-face meetings with networking aspects and call this approach Blended Networking. We apply Blended Networking in the project MV-3D4KMU to teach mobile mapping and collaborate with experienced professionals.

We share our experience with Blended Learning and Blended Networking. Both approaches proved to be efficient when applied in a well-structured framework. In this paper, we explain how to structure the development process of these lectures and settings, how to successfully conduct such lectures. We give recommendations based on our experience for both methods. We encourage to use and assess these novel approaches to sustainably implement lectures in adult education and educational networking.

---

Use of Blended Learning and Blended Networking in Adult Education in the Fields of Study Photogrammetry and Mobile Mapping (10740)  
Valentin Wich, Jürgen Selenski and Ansgar Brunn (Germany)

FIG Working Week 2020  
Smart surveyors for land and water management  
Amsterdam, the Netherlands, 10–14 May 2020

# Use of Blended Learning and Blended Networking in Adult Education in the Fields of studying Photogrammetry and Mobile Mapping

Valentin WICH, Jürgen SELENSKI, Ansgar BRUNN, Germany

## 1. INTRODUCTION

It is common to use a mix of media and different online and offline situations in adult education. Different terms describe these phenomena. We use Blended Learning (BL) and Blended Networking (BN) as methods to teach Photogrammetry and Mobile Mapping. Blended Learning means mixing online lectures and face-to-face teaching. BN brings people together to learn in a team-like group.

We use Massive Open Online Courses (MOOC) to implement online lectures in BL. MOOC have the potential to deliver high quality content to a big audience. Thus, financing the process of creation is easier than in traditional university lectures. Students have a flexible learning experience using online lectures. They have the possibility to study independent of place and time.

BN uses BL and extends the approach by networking amongst all attendees. BN is the concept to found a consortium to share ideas, learn and exercise. We depict both settings in this paper with the structure how to implement a BL and a BN setting.

We describe structured approaches to implement BL and BN. A well-defined structure is required to study, because self-study needs self-propulsion. We found online lectures are a great tool to introduce a topic and to present knowledge about an already discussed topic. New topics to be introduced require face-to-face lecture to motivate learners. Motivation is the key, e.g. by explaining the subjects outlines and to encourage students with stunning ideas. The mind set needs to be in the right mood to self-study and exercise.

The choice of method should be based on your requirements: We experienced BN as a suitable tool in teaching professionals with academic background or students at higher educational levels, because sharing experience is beneficial for the whole network. This enables an active exchange of ideas. Networking enhances group cohesion and leads the group towards collective actions and therefore towards progress. MOOCs are a great tool to extend face-to-face lecture and give further information. Interactive elements help to track the learning progress and to individually support learners.

## 2. THEORY

### 2.1 Blended Learning

BL is a motivating, encouraging method in adult education. Students are free to choose when and where to learn. Recordings of already held classroom lectures allow to repeat content. Additional online material extends new topics introduced by using face-to-face lecture. We

---

Use of Blended Learning and Blended Networking in Adult Education in the Fields of Study Photogrammetry and Mobile Mapping (10740)

Valentin Wich, Jürgen Selenski and Ansgar Brunn (Germany)

FIG Working Week 2020

Smart surveyors for land and water management

Amsterdam, the Netherlands, 10–14 May 2020

tailor the courses to the student's abilities and needs. Combining online and lecture held in presence allows effective learning settings.

Good organization is vital for success of the self-study approach. Students need self-propulsion to self-study. The face-to-face lecture should encourage students besides the informal parts. The overall course structure and goals should be clear from the beginning. Kraft suggests good combinations of E-Learning and face-to-face lecture (Kraft, 2003).

BL uses a mix of different media. Plain ASCII or Hex-Codes would not be very understandable for learners. A mix of media addresses more senses, that leads to a gain more of attention. Video, imagery, audio and text make lectures more entertaining. A state-of-the-art use of technology engages students to learn more than using traditional textbooks and print media (Holten & Nittel, 2010).

BL was used to fuse online and offline parts in the project about digital photogrammetry for SME "Digitale Photogrammetrie für kleine und mittlere Unternehmen" (DiPhoBi4KMU). Brunn and Meyer provided in-class exercises, online lecture and a comprehensive online guide. Most of the participants had an academic background in geodesy. Each concept has a small lecture online. The lecture is explained in face-to-face meetings and exercises helped to apply the gained knowledge. The method proved to be efficient and well applicable (Meyer & Brunn, 2016).

## **2.2 Blended Networking**

We can multiply knowledge in a network setting. Everyone can commit splendid ideas and good practices to the network. Networking enhances group cohesion and leads the group towards collective actions and progress.

DiPhoBi4KMU had project participants with an almost homogeneous academic background. Brunn introduced networking as a tool for better communication and knowledge transfer in adult education (Brunn, 2018).

We use BN in our current Project about Mobile Mapping for SME "Mobile 3D Vermessung für kleine und mittlere Unternehmen" (MV-3D4KMU). We assess this as a very useful approach to share knowledge, even after a short time and shared first results on our professional network for photogrammetry and remote sensing (Wich & Brunn, 2019).

Networking lectures have many benefits. A network works best with active contributions of its members. Members should be able to apply the learned. Participants therefore use own notebooks to solve interactive tasks and exercises. Participants have the freedom to interact with the network to find solutions to tasks.

In rare cases tasks are too difficult to solve. We address the problem in a way all participants understand and suggest a solution. Sharing skills and information is a key to solve complex

tasks. Participants learn to share and rely on the network. It can reduce the participant's workload and participants get outstanding results by collaboration.

We provide opportunities for students by providing new research topics in MV-3D4KMU. Students can apply for a topic of interest. Network partners have the opportunity to share knowledge of their companies and to apply new results. Students use the network as a platform to demonstrate skills and new findings. Students can contribute with their written theses or thesis presentations. If a topic is of interest for a SME, network partners can initialize a first contact to collaborate. Some collaborating students found their job at network partners companies this way.

Scheduling face-to-face meetings in our project network require slots with time to enhance the network. Face-to-face lectures include a coffee break and a lunch break. We schedule time for network partners to arrive, to meet and to exchange. The coffee break is a good tool to relax and get to know about the well-being of others. Network partners use this to initialize first contacts and to socialize. Another valuable networking event is the lunch break. Participants often use it to exchange about their current projects and to socialize. Socialization leads to better relationships.

Excellent relationships lead to successful collaborations. The last agenda item is an open discussion, to answer questions and participants can network, too, moderated by the project leader. Everyone has as much time as necessary to exchange, share ideas or establish new contacts.

### **2.3 Massive Open Online Course**

The project SMART vhb, setup by institution "Virtuelle Hochschule Bayern" (vhb), implements a Massive Open Online Courses (MOOC). vhb is the joint virtual campus of the Bavarian universities and colleges for applied sciences. They give formal recommendations for development and the implementation of interdisciplinary online teaching.

We found MOOC as the perfect tool to extend existing lectures. MOOCs have the potential to deliver high quality content to a big audience. Thus, financing the process of creation is easier than in traditional lectures. Students gain flexibility when they use online lectures to learn (Wulf et al., 2014).

The mind-set of the learning individual need to be in the right mood to self-study. We suggest to use classroom trainings to start a MOOC. It is important to make learning easy. Start by explaining where and how to access the MOOC. You can walk through an online lecture together and explain basic ideas. Face-to-face lecture is key to encourage students with stunning ideas and explain the course concept.

## 2.4 Gamification for Immersive Online Learning

Gamification is a great tool for an immersive experience in learning. Gamification intends to be a playful experience with focus learning through interactive elements. It uses principles that serious games have: excitement, fun, competition, exploration of the new and more. It leads to more engagement and makes learning progress better measurable.

Implementation of gamification elements should be fast and with little effort. Use existing tools and do not waste time in programming own game elements. We use two simple forms of gamification in MV-3D4KMU. We use “Level Up!” (Branch Up Pty Ltd, 2017) to rank learners and to assess the online learning progress. Competitive quizzes like Kahoot.it (Kahoot! AS, 2020) are an engaging element in face-to-face lecture. Keep its development simple and save time. Use the saved time to engage and to individually support learners.

## 3. METHODS

### 3.1 Standard Process for Online Course Development

#### 3.1.1 Development of a Storyboard

The drafting process begins with a plain document in a word processor. A title and short notes give the frame for each lecture. These notes are the raw material for further investigation. Scientific staff searches literature and web resources.

A storyboard helps storing all searched information. The template of the storyboard comprises a table with three columns: Note, Content, and Media. Each note gets new reference items based on search results. Sometimes it makes sense to rearrange the order of items to have a golden thread running through the lecture. The scientific staff discusses the online lesson draft with the professor. The professor can edit the script and suggest further improvements.

#### 3.1.2 Research for Online Lecture Script with Content and Media Editorial

Media depict concepts and principles in lectures. Some media requires editing: videos, images and formulas should fit to the lecture’s context. The full text and media editorial is designed to search media and text content for each lecture. The research results are stored inside a table with its reference. The final draft is presented for approval.

We use Open Educational Resources (OER) and content which is licensed as public domain with Creative Commons Zero (CC0) license (Creative Commons Corporation, n.d.).

Since 2002, when the term Open Educational Resources (OER) first emerged, OER has increasingly been recognized by the international community as an innovative tool for meeting the challenges of providing lifelong learning opportunities for learners from diverse levels and modes of education worldwide. Free license models allow sharing created online lectures without paying additional fees for media licenses (UNESCO, 2017).

### 3.1.3 Online Lecture Authoring

The choice of Authoring software depends on the used Learning Management System (LMS), the learning setting and the goals of the lectures.

In MV-3D4KMU, we use newsletters, videos and HTML to implement most of our lessons. A “what you see is what you get” (WYSIWYG) editor helps to develop rich text and HTML lessons. Video is an even easier way to understand, entertaining, a time efficient format. Organizing videos similar to a slideshow helps to keep video lessons maintainable. Slides allow for easier partial editing or rearrangement of lessons if change requests happen after publication on our LMS.

SMART vhb focusses on producing online lectures. The tool to create interactive lessons is Lectora Inspire (Trivantis, 2020). The implementation process in Lectora begins with the universities template using a corporate design. Predefined template elements are used as place holders. The developer uses the elements by copying the template. He replaces the templates place-holders with text and media from the reviewed script. The text and images need to fit the predefined space. A container can also be used to embed videos. Videos can be uploaded or inserted by URL of the web resource. Then, the lecture is ready for assessment and gets a questionnaire for evaluation.

### 3.1.4 Online Lecture Assessment and Improvement

Students in higher semesters work as assistants and have the opportunity to learn and help to maintain the high-quality standard. Assistants work through each lecture and fill questionnaires at the end of lessons to suggest changes. Questionnaires could suggest to write in a different way, e.g. to achieve better readability or clarity of content, correct orthographic mistakes, to solve technical issues, give further explanation, or hints to use more media.

The developer uses the submitted feedback of questioners to improve the online content. He uploads the edited lectures to the vhb hidden space of the repository. vhb peer reviews all resources, gives approval or suggests editing. The approved lectures visible and embeddable to a LMS like Moodle (Moodle Pty Ltd, 2019) for all collaborating universities.

## **3.2 Structured Approach to Implement a Blended Learning Setting**

BL and BN are more efficient to implement by using a comprehensive structure. Online lectures are suitable to cover basic knowledge. We should not put complex topics in a big, time consuming lesson. Splitting complex topics in smaller parts with a golden thread make sense to keep tension. It is more fun to achieve smaller goals. We implement each part a lecture without any direct dependencies to previous lectures. Of course, pre-knowledge helps in working through the courses.

Students are used to the combination of online and offline lecture from their daily lives. It appears to be natural for digital natives to personally and digitally meet and connect with others. The BL setting starts with announcing the contents and structure of the lecture. A face-to-face

introduction explains basic concepts. Advanced topics are explained and a real-world example is given. A transfer task helps to assess students' knowledge. Advanced topics and outlook encourage learners.

Online preparation for the next lecture makes learning easier, because learners already having concept in mind when they attend face-to-face lessons. It is good for learners to try to understand lessons by self-study and prepare questions in case of doubt. This kind of preparation and repetition leads to an efficient learning setting with long term benefits.

Example of a Blended Learning Setting

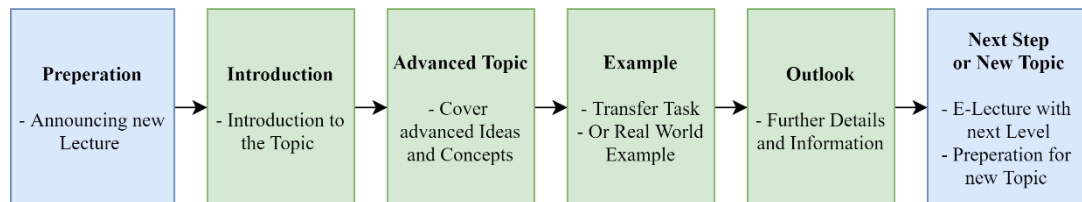


Figure 1: Implements a BL setting using online lecture (blue) and face-to-face teaching (green).

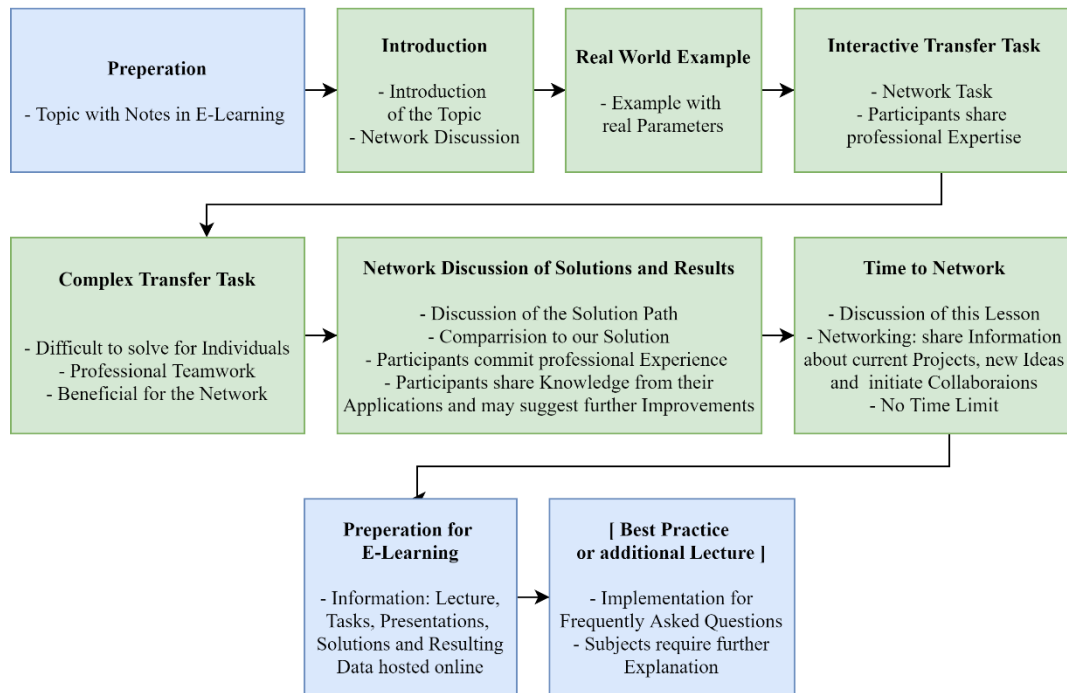
### 3.3 Structured Approach to Implement a Blended Networking Setting

BN works on top of BL techniques. It combines both online and offline lecture. It uses a face-to-face networking lesson with extended real-world examples, multiple transfer tasks, discussion and networking aspects. We found it needs more preparation time for networking events, but it is more sustainable through more exercises and the networking aspects. The exercises and relying on the network allow to solve issues and to share advanced concepts and ideas.

Networking is beneficial for collaboration and teamwork. Networking time is vital for socialization. We intentionally give more time for the coffee and lunchbreak. We introduced an open discussion after each networking lesson to have time for more socialization. Socialization leads to good collaboration and a to better communication practices. Through personal relationships, participants freely share ideas and concepts in our network and collaborate with other partners.

Project participants have a professional background and applied expertise. Real-world examples are important for acceptance and to get the real-world significance of an issue. A preparation of example is key to have premade solution parts before the face-to-face lecture takes place. Complex transfer tasks are good to apply the new knowledge. Networking helps to find good solution paths. Solution paths are discussed and are compared to our solutions, based on efficiency, quality and speed of solution. Participants contribute with their experience, share ideas, guess how important the topic and impact are for their own real-world business applications. Networking content and online lessons are centrally available in our LMS. We derive best practices for frequently asked questions. We do also prepare additional lectures, if requested, to give further explanation on topics that students are interested in.

## Example of a Blended Networking Setting



**Figure 2: BN Setting with focus on face-to-face networking. Complex tasks require relying on the network and collaboration. Time to network and socialize is vital for good communication. Solutions, ideas, content and references for further information is gathered online in our LMS. We derive best practice guides online, if required and share them on our LMS.**

## 4. RESULTS

### 4.1 Online Lecture Production in SMART vhb

The project SMART vhb" is about various topics in photogrammetry. Topics begin with basic camera modelling, explain how optics and a sensor works and cover more complex topics like colour and colour spaces in advanced lessons. Each lesson is enriched with additional metadata to get better search results over all contents. We contribute to a common repository along with other universities. All members of Bavarian universities can access the online lessons. Bavarian lecturers can additionally embed the lessons in their LMS using a plugin.

Interactive elements and mini games are an exciting experience. Students need to transfer their new knowledge to solve riddles. It is also a good practice to use it as a control mechanism for self-study lectures. If students recognize they were wrong or where distracted, they can navigate to previous slides, learn and solve the task. vhb oversees the process and provides a common repository to share online lectures. vhb provides good practices about creating, contributing, sharing and assessment of lectures (Virtuelle Hochschule Bayern, 2019).



**FH·W·S**

Photogrammetrische Objektmessung  
Photogrammetrische Kameramodellbildung

14 / 18

Drag & Drop Quiz: Modellierung des photogrammetrischen Abbildungsprozesses

Ordnen Sie die Buchstaben auf der linken Seite den dazugehörigen Fragezeichen auf der rechten Seite zu.

Objektpunkt

Bidpunkt

Projektionszentrum

Objektpunktvektor  $X^*$

Bildpunktvektor  $X'$

**Figure 3: Interactive drag 'n Drop Quiz to learn the basic terms in photogrammetry in vertical images. The symbols and its terms are on the left and can be dragged to the figure space on the right using the mouse. You get a notification if all terms are put correctly.**

#### 4.2 Online and Offline Networking and Lecture in MV-3D4KMU

We use Moodle to share online content and organize the project. The platform hosts lectures with HTML content, texts, imagery and videos. We use plugins like Adobe Connect to set up interactive webinars (Adobe, 2020).

Lectures in MV-3D4KMU are about photogrammetry, laser scanning and mobile mapping. The lectures cover: basic photogrammetric principles, e.g. optical- and mechanical components of a DSLR, different cameras, and sample calculations for practical situations. Laser scanning topics are optical- and mechanical components, mathematics, and different categories of laser scanners and computational examples with applications in several real-world situations. Mobile mapping topics cover: GNSS and IMU filtering, integration of sensors like laser scanners and cameras, and project planning and calculations to get reliable estimates for planned missions.



a)



b)

**Figure 4: Video lecture a) begins with a flow-chart for a fast video content insight. A short text contains a detailed description to give a relevance estimator for learners. The newsletter b) begins with a brief introduction. Participants the introduction via E-Mail to time-efficiently decide if content is worth a read.**

## 5. CONCLUSION

The key of being successful in learning is engagement through excitement and fun. Interactive elements, possibilities to contribute own results, and to discuss the results in a network are means to consume knowledge in an immersive, sustainable way. We encourage further discussions whether BL or BN is the suitable approach for your lectures.

We found BL allows fast implementation of online lectures when lecture scripts are already available. Complex topics require a well thought step-by-step approach with multiple lectures guided by a golden thread. BL should be implemented as MOOC and integrated in face-to-face lectures. It synergistically combines online and offline teaching and both lesson distribution and financing are easier. Online preparation can save time that educators can use for individual learning supervision in face-to-face situations.

BN is a great method to introduce complex topics. It is a splendid tool to establish personal relationships, exchange in a network and encourages learners to give their best in all situations. Teambuilding and socialization lead to successful collaborations. It is a great tool in adult education and helps to find well-thought solutions for complex issues.

We recommend to use and assess BL and BN for lectures and share your own experiences. Both methods enhance adult education and make it more efficient and sustainable. We are looking forward to an active exchange about ideas and concepts on BL and BN. We are looking forward to exchange new insights using a common network e.g. FIG, DGPF and ISPRS.

---

Use of Blended Learning and Blended Networking in Adult Education in the Fields of Study Photogrammetry and Mobile Mapping (10740)

Valentin Wich, Jürgen Selenski and Ansgar Brunn (Germany)

FIG Working Week 2020

Smart surveyors for land and water management

Amsterdam, the Netherlands, 10–14 May 2020

## REFERENCES

- Adobe. 2020. "Adobe Connect." *Adobe Web Conferencing Software*. Retrieved February 6, 2020 (<https://www.adobe.com/products/adobeconnect.html>).
- Branch Up Pty Ltd. 2017. "Level up! Gamification for Moodle." Retrieved February 12, 2020 (<https://levelup.plus/>).
- Brunn, Ansgar. 2018. "Blended Learning in Photogrammetrie und Bildverarbeitung für regionale KMUs – Ein Erfahrungsbericht." 38. *Wissenschaftlich-Technische Jahrestagung der DGPF und PFGK18 Tagung in München – Publikationen der DGPF* Band 27:450–60.
- Creative Commons Corporation. n.d. "CC0 1.0 Universell." Retrieved November 5, 2019 (<https://creativecommons.org/publicdomain/zero/1.0/legalcode>).
- Holten, Roland, and Dieter Nittel, eds. 2010. *E-Learning in Hochschule und Weiterbildung: Einsatzchancen und Erfahrungen*. Bielefeld: Bertelsmann.
- Kahoot! AS. 2020. "Learning Games Make Learning Awesome!" Retrieved February 12, 2020 (<https://kahoot.com/>).
- Kraft, Susanne. 2003. "Blended Learning – ein Weg zur Integration von E-Learning und Präsenzlernen." *REPORT Literatur- und Forschungsreport Weiterbildung: Erfahrungen mit Neuen Medien* (2003(2)):43–52.
- Meyer, Theresa, and Ansgar Brunn. 2016. "Digitale Photogrammetrie und Bildverarbeitung für kleine und mittlere Unternehmen durch „Blended Learning“." *Dreiländertagung der DGPF, der OVG und der SGPF in Bern, Schweiz – Publikationen der DGPF* Band 25:436–48.
- Moodle Pty Ltd. 2019. "Moodle: Online Learning with the World's Most Popular LMS." *Moodle*. Retrieved February 6, 2020 (<https://moodle.com/>).
- Trivantis. 2020. "Lectora Inspire ELearning Software." *Trivantis*. Retrieved February 6, 2020 (<https://www.trivantis.com/products/inspire-e-learning-software/>).
- UNESCO. 2017. "Open Educational Resources (OER)." Retrieved February 18, 2020 (<https://en.unesco.org/themes/building-knowledge-societies/oer>).
- Virtuelle Hochschule Bayern. 2019. "SMART vhb: Blended Learning." *vhb*. Retrieved November 5, 2019 (<https://www.vhb.org/lehrende/smart-vhb-blended-learning/>).
- Wich, Valentin, and Ansgar Brunn. 2019. "Methodik des Blended Learnings im Bereich der Aus- und Weiterbildung der mobilen 3D Vermessung." *reiländertagung der DGPF, der OVG und der SGPF in Wien, Österreich* Band 28:270–81.

---

Use of Blended Learning and Blended Networking in Adult Education in the Fields of Study Photogrammetry and Mobile Mapping (10740)

Valentin Wich, Jürgen Selenski and Ansgar Brunn (Germany)

FIG Working Week 2020

Smart surveyors for land and water management

Amsterdam, the Netherlands, 10–14 May 2020

Wulf, Jochen, Ivo Blohm, Jan Marco Leimeister, and Walter Brenner. 2014. "Massive Open Online Courses." *Wirtschaftsinformatik* 56(2):127–30.

## **BIOGRAPHICAL NOTES**

M.Sc. Valentin Wich works at FHWS on the project MV-3D4KMU. It is about knowledge transfer small and medium-sized companies (SME) using the Blended Networking format. The focus is on collaboration within the network in order to make joint use of the experience of SMEs and FHWS. The learning modules cover photogrammetry, laser scanning and mobile mapping.

B.Eng. Jürgen Selenski works at FHWS on the project SMART vhb. During the project online learning modules are implemented. He has experience in surveying, photogrammetry and image processing. He designs and implements online lessons with Lectora Inspire for Blended Learning.

Prof. Dr.-Ing. Ansgar Brunn heads the departments of photogrammetry, laser scanning and remote sensing at FHWS. Since his PhD in 2008 he has been using the e-learning system of the FHWS intensively. All university courses are supplemented by e-learning in Blended Learning format. The lectures are constantly extended and updated to state-of-the-art possibilities. With MV-3D4KMU he contributes to the education and training for SMEs in the field of mobile mapping in Bavaria using Blended Networking. He is part of the DGPFs committee in the field of education and training, contributes to the network with participation and publications, and is chair of the ISPRS WG V/4 "Web-based Resource Sharing for Education and Research".

## **CONTACTS**

M.Sc. Valentin Wich, B. Eng. Jürgen Selenski, Prof. Dr.-Ing. Ansgar Brunn  
University of Applied Sciences Würzburg-Schweinfurt  
Röntgenring 8  
97070 Würzburg  
Germany  
Tel. +49 (0) 931 3511 8502  
Email: { valentin.wich, juergen.selenski, ansgar.brunn }@fhws.de  
Website: [geo.fhws.de](http://geo.fhws.de)

---

Use of Blended Learning and Blended Networking in Adult Education in the Fields of Study Photogrammetry and Mobile Mapping (10740)  
Valentin Wich, Jürgen Selenski and Ansgar Brunn (Germany)

FIG Working Week 2020  
Smart surveyors for land and water management  
Amsterdam, the Netherlands, 10–14 May 2020