



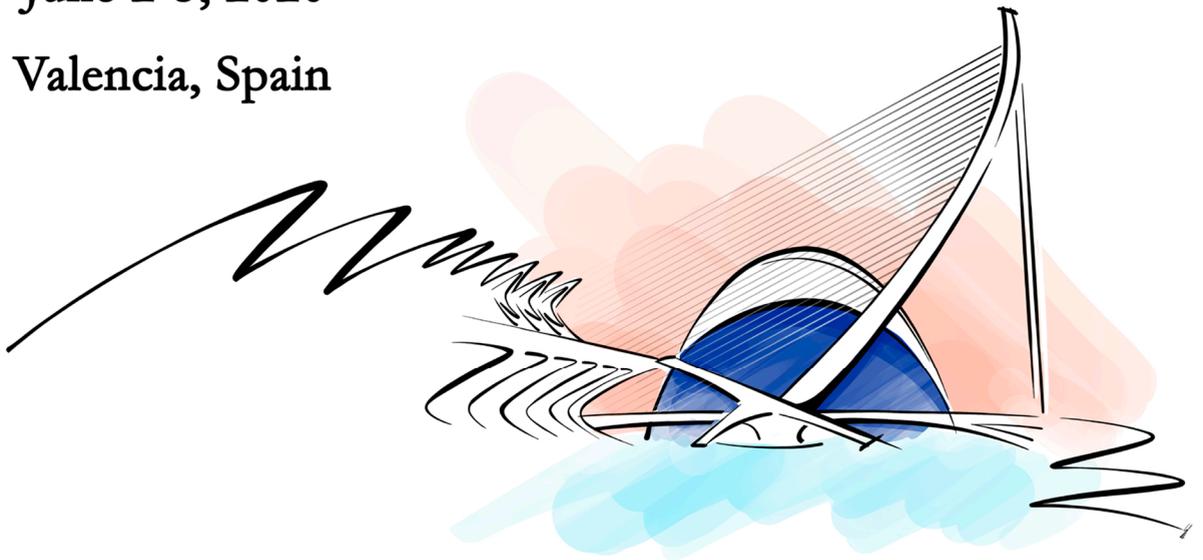
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# HEAd '20

## 6<sup>th</sup> International Conference on Higher Education Advances

June 2-5, 2020  
Valencia, Spain



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6th International Conference on Higher Education Advances (HEAd'20)

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## Preface

**Josep Domenech<sup>1</sup>, Paloma Merello<sup>2</sup>, Elena de la Poza<sup>1</sup>, Raúl Peña-Ortiz<sup>2</sup>**

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### ***Abstract***

*The series of HEAd conferences have become a leading forum for researchers and practitioners to exchange ideas, experiences and research results relating to the preparation of students and the organization of higher educational systems. The sixth edition (HEAd'20) was celebrated during 2-5 June 2020. It was organized from Valencia, Spain; although held virtually because of the COVID-19 outbreak. This preface gives an overview of the aims, objectives and scope of HEAd'20, as well as the main contents of the scientific program and the process followed to select them.*

**Keywords:** *Higher education, innovative materials, educational technology, evaluation and assessment, globalization in education.*

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## **1. Preface to HEAd'20**

This volume contains the selected papers of the Sixth International Conference on Higher Education Advances (HEAd'20), which was virtually organized from Valencia, Spain during 2-5 June 2020. Despite the COVID-19 outbreak, this sixth edition was a great success of participation and consolidates the series of HEAd conferences as a leading forum for researchers and practitioners to exchange ideas, experiences and research results relating to the preparation of students and the organization of higher educational systems.

The selection of the scientific program was directed by Paloma Merello, who led a team of 229 program committee members representing 50 countries in all five continents. Following the call for papers, the conference received 280 full paper submissions from 47 different countries. All the submitted papers were reviewed by at least two program committee members under a double blind review process. Finally, 121 papers were accepted as full papers for oral presentation during regular sessions. Additionally, 42 submissions were accepted for presentation in the innovative non-linear sessions, which allowed for increased interaction and participation. The program committee chair congratulates all the authors for having their papers accepted in the proceedings of such a competitive conference.

HEAd'20 also featured two keynote speakers that overviewed important and actual topics: Dr. César Ortega-Sánchez (Curtin University, Australia) talked about understanding students' needs in the age of the Internet, relating this to the change in the learning process due to the mobility restrictions approved after the coronavirus outbreak. The second keynote speech was delivered by Dr. Janet Lord (Manchester Metropolitan University, United Kingdom) dealt with the transformative leadership for equity, social justice and change in higher education.

The main conference was preceded by the Special Interest Group symposium entitled Pedagogy for Higher Education Large Classes (PHELC). This virtual workshop, led by Ann Marie Farrell and Anna Logan, celebrated its second edition by focusing on the assessment for large classes.

Although virtually held, the conference was hosted by the Faculty of Business Administration and Management of the Universitat Politècnica de València, which has been recently ranked as the best technical university in Spain by the Academic Ranking of World Universities (ARWU) 2019.

The organizing committee would like to thank all of those who made this year's HEAd a great success. Specifically, thanks are indebted to the invited speakers, authors, program committee members, reviewers, session chairs, presenters, sponsors, supporters and all the attendees. Our final words of gratitude must go to the Faculty of Business Administration

and Management of the Universitat Politècnica de València for supporting, once again, the HEAd conference, making it possible to become a great event.

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## **The Impact of Government Policy on Higher Education International Student Recruiters**

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### ***Abstract***

*This paper explores higher education actors involved in the recruitment of international students and their perceptions of their home country's government policy on their practice. It examines case study institutions from three countries Canada, Hong Kong, and the United Kingdom. This study shows higher education institutions do not exist in a vacuum and regardless of their location, government policy shapes perceptions for international student recruiters who believe that government policies contribute or hinder their practice. All of the participants, regardless of location, show a high level of awareness of government policy that greatly shapes their strategies. More specifically, recruiters find tensions arising from these policies with government shaping recruitment priorities and restricting or instigating competitive responses, while their institutions do not challenge government policy (enough). The findings suggest that government policies establish the "playing field" for recruiters as they attempt to navigate an increasingly competitive environment but at the same time, these perceptions are highly localized and need to be understood in their individual settings.*

**Keywords:** *internationalization; government policies; recruiters; students.*

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## **1. Introduction**

This study compares higher education institutions (HEI) from different parts of the world to understand how their government policy frameworks shape practice for international student recruiters. It argues that international student recruitment for HEIs is complex due to government policies and these policies may have direct or in-direct impacts on the practice. There is much unknown about how actors involved in international student recruitment activities conceptualize and respond to government forces. Other studies argue for greater understanding of international student recruitment activities in HEIs from the supply-side and the challenges faced by those involved in the practice as institutions aim to manage government policy changes and other forces on their practice (Asaad et al., 2015; Findlay et al., 2017; Mosneaga & Agergaard, 2011; O'Connor, 2017; Zinn & Johansson, 2015). There is a need for more critical perspectives on international student recruitment practice to offer accounts and descriptions from those involved and how they interpret government policies in their day-to-day practice. This study will provide these perspectives and will further our understanding of how government policy shapes international student recruitment from the supply-side (Findlay et al., 2017).

## **2. Literature Review**

The link between government policy and international student recruitment is currently not well understood (O'Connor, 2017; Sá & Sabzalieva, 2017). O'Connor (2017) studied international strategy from the student and institutional perspective at an Irish university and found there are conflicts in the practice of recruiting international students that are highly local. Their national and local institutional policies are designed to attract international students for economic recovery and diversity, but the institution had a passive acceptance of these students, impacting the international student experience on campus. This study examines one institution in Ireland and sheds light on practice problems associated with government policies that affect the recruitment of international students and suggests further studies of institutions in other jurisdictions will hold value (O'Connor, 2017). This study supports this argument that further research is necessary to understand government policies in the context of local, institutional dynamics and that institutional actors shape practice based on their interpretations of these policies.

These practices suggest a competitive and marketized landscape at a national level that contributes to local, institutional approaches to international student recruitment. Previous studies show marketization and government policy shaping higher education and argue it is important to examine institutional level impacts in the context of their government policy frameworks (Cudmore, 2005; Marginson, 2017; Mosneaga & Agergaard, 2011, O'Connor, 2017, Sá & Sabzalieva, 2018). Beech (2018) explored international student recruitment staff

from ten UK institutions. This study examined changes to the UK visa system and the impacts on recruitment methods through the relationships staff had with educational agents. It found that student mobility is an industry driven by market forces and institutional responses are important in facilitating student mobility. Geddie (2015) furthers this argument in a study of twenty-nine higher education policymakers in the UK and Canada and found that national policies change and evolve at local levels and that there are “perceived competitive relations between places and actors” (p. 245). This suggests that actors’ perceptions at local, institutional levels are important in conceptualizing government policy.

Similarly, Findlay et al. (2017) study of stakeholders in the UK higher education sector show that institutions and inter-university organizations have different motivations to attract international students to the UK and suggest that financial motives and the drive to be “globally excellent” serves to position institutions globally to attract international students. At the same time, respondents in the study perceived government policy to restrict these objectives. Findlay et al. (2017) is a comprehensive study of international students who chose to study in the UK and a small set of actors involved in attracting students to the UK. Findlay et al. (2017) argue more studies need to examine the institutional or supply-side perspectives of international student recruitment as there is limited literature on internal operations of HEIs and how they perceive government policies on their practice. This study extends studies such as Findlay et al. (2017) and O’Connor (2017) by taking the supply-side view (or institutional view) of international student recruitment practice by exploring practitioners, in three different countries, as a basis to compare their perceptions. It does this by examining complexities such as government policy contexts and how practitioners view these policies impacting their practice. These studies show that system actors may have different perspectives on government policies, but little is understood about how these policies are perceived. Furthermore, there are limited comparisons of international student recruitment practitioners from different countries. This study explores the local, institutional response government policies facing practitioners of international student recruitment in Canada, Hong Kong, and the UK.

### **3. Methods**

The study examines three institutions from three separate countries in an international comparison. The main research question guiding this study is how do practitioners’ view of government policies as influencing their international student recruitment practice? As such, the primary data for this study considers the views and perspectives of the participants involved in international student recruitment in each case in the context of their national policy frameworks that existed in 2017. Therefore, semi-structured interviews with international student recruitment practitioners were the primary data collection method in this study while document analysis of government policies was used to inform the interview guide and

contributed to understanding the context and settings. This paper uses case study method to explore the practice of international student recruitment at three HEIs and examines the perspectives of participations thereby creating a cross-case study analysis (Stake, 2013). Case study research is useful for institutional management as it allows for several data sources in real-world contexts, where there was no previous research before (Jensen & Rodgers, 2002). There are few empirical studies on HEIs, and the case study approach provides the flexibility to examine multiple sources and to gather appropriate qualitative data for the study.

The case study sites are the University of Prince Edward Island, Canada (UPEI); the University of Hong Kong, Hong Kong (HKU) and Lancaster University, United Kingdom. Each of these institutions actively recruits international students (both graduate and undergraduate). An important factor in choosing the case studies was the different national settings that shape international student recruitment presenting opportunities to compare institutions. While each institution showed that 20 – 26% of their student population is international, recruiters may view their practices differently and face similar or different challenges in their practice as a result of these policies. These unique circumstances contribute to understanding government policy influence in each case by recognizing these macro-level policies may have different impacts than anticipated and these impacts on international student recruitment have not been previously explored in an international comparison of three separate countries.

The sample consisted of participants within each institution who are directly involved in attracting prospective international students. These are typically individuals with titles such as recruiter, international manager, or overseas manager. Within each institution, the sample was purposive in that only those individuals who had direct involvement with students were invited to participate. The size of the sample varied according to the number of individuals involved in the practice until a saturation point was reached, meaning a sufficient number participants representing the functional areas of the collective activity were interviewed (Guba & Lincoln, 1994). This point was measured in all institutions, as there were a finite number of potential participants. As such, the study involved three interviews at the University of Hong Kong case study (population three); four interviews at the UPEI case study (population six); and seven interviews at Lancaster University (population eleven). This variation in size was reflective, not only of the level of effort and resources dedicated to international student recruitment but also how the institutions assigned responsibilities. In total, the study involved fourteen interviews across the three case study locations. The interviews were conducted in-person and each one recorded.

#### 4. Findings

The findings show the three case study HEIs share similar perceptions of government policy on their practice namely that these policies act as a “playing field” and restrict their ability to compete and respond to competitive markets. However, the participants’ views of national policies suggest local context is needed. For example, UPEI understood that government played a central role in funding the jurisdiction’s only university and the participants viewed the government as an enabler of international student recruitment. Meanwhile, the other two institutions viewed government and their policies as a constraint and participants viewed government as negatively impacting their practice through policies. The subjects at HKU and Lancaster believed the policies inhibited international student recruitment efforts through the quota for HKU and immigration policy for Lancaster University. These views of government were unique to each case study as the policies and relationships with government varied in each setting (Beech, 2018, Findlay et al., 2017, O’Connor, 2017).

The Hong Kong government through the UGC established the quota for international students to HKU and this quota system monitored compliance. The quota served to mediate international student recruitment by limiting the number of students who can attend the institution. As such, government controlled the nature and extent of international student recruitment at HKU. The institution recruited students by adopting strategies that focused on the institutional brand and by attracting “top students”. At the same time, the quota limited the scope of international student recruitment for the institution, both in financial and human terms. There was less incentive to dedicate resources to actual recruitment practice when the quota limited capacity and financial gains (Asaad et al., 2015). The quota also constrained the choice of markets that the recruiters visited and forced the recruiters to direct resources to China, limiting diversity and choice of top students. *“Mainland China is not international, but it’s not local”* (interviewee 3, HKU). This government view of international students directed China to be the main market for HKU, but it also created divergent priorities for the institution. *“You have to prioritize and you’re obviously trying to get as many representation as you can within the 600 number, this magic number that’s been hanging over our head”* (interviewee 3, HKU). Six hundred were the maximum number of students that HKU could enroll based on the quota system. As such, international student recruitment strategies were adopted based on the parameters established within the quota system and necessitated the recruiters to make decisions that adhered to the six hundred limit while ensuring Mainland Chinese students were a main contributor to their target.

In the UK, Lancaster also experienced government policy constraints in the form of the removal of the post-study work visa and the on-going Brexit discourse. Participants discussed government policy and media communication as shaping perceptions amongst prospective students and this created challenges for recruiters as they attempted to overcome these negative messages.

*“It is just negative media that gets out. A few years ago, was the close of the post study work visa. Messaging went out to say that UK is closed (closed borders for students), you can’t work you got to go home. So I think there are certain markets where India being one, the students are expected to stay in country, get some work experience, get a job, earn some money, pay off some of their debts before returning home. So, Government policy now is restricting that”* (interviewee 8, Lancaster).

The participants discussed the challenges of negative government policies as the realities they faced as they entered markets or established recruitment priorities. Recruiters believed the policies and discourse is well known amongst prospective students and that recruiters had to overcome negative perceptions of the UK in their approach to students.

Meanwhile, in Canada, the national and provincial government had placed considerable importance on recruiting international students for economic benefits. *“We need to import talent, train them, and encourage them to stay, develop businesses and contribute to the economy. (interviewee 1, UPEI)* This neo-liberal approach to attracting international students created a national policy environment that encouraged the international student recruitment game for HEIs in Canada. This raised expectations for institutions to attract students for national economic interests but also for institutional sustainability. At UPEI, 50% of their operating budget came from self-sourced revenues such as students (“Short-term Enrolment Plan”, 2016). Even though government funding may be challenging for HEIs, the recruiters at this institution viewed immigration and marketing policies from all levels of government as highly positive.

## **5. Discussion and Conclusion**

The case studies exist in different government policy contexts that influence their practices of attracting international students. In Hong Kong, international student recruitment was highly controlled with a quota system while in Canada it has become progressively more flexible to attract international students to study and work post-graduation. At the same time, the UK is experiencing a shifting policy environment in immigration that respondents describe as impacting the recruitment of international students. The findings show that the institutions do not exist in a vacuum and regardless of their location, government policy shapes perceptions for recruiters who believe that government policies contribute or hinder their practice. All of the participants, regardless of location, show a high level of awareness of government policy that greatly shapes their strategies. *“Key export trends (e.g. competition, regulation) should be constantly monitored...to formulate marketing strategies that are aligned to changes in export market conditions”* (Asaad et al., 2014, p. 156). This study provides insight into how recruiters perceive government policy impacting their international student recruitment practice. These findings confirm the importance of close

monitoring of government policy for international student recruitment (Asaad et al., 2013, 2014, 2015; Hemsley-Brown & Oplatka, 2010; Marginson, 2017, Sá & Sabzalieva, 2018) and further suggest that the impact of policy be discussed and understood amongst all actors involved in the practice (Ross et al., 2013). As HEIs expand their recruitment efforts, greater attention needs to be paid to these investments. *Fundamentally, all colleges and universities do the same things and deliver the same things. This sets up a race to build more and grow larger*” (Sickler, 2017, p. 4). This should assist institutions to contextualize to national policy changes on their practices thereby enhancing their understanding of the impacts of these investments.

These findings are of value to policy-makers, administrators, and researchers, regardless of country or HEI. These insights may be used to understand national policy changes on institutional strategy and enable institutions and governments to collaborate in positive manner. This study showed that there is value in examining actors’ perceptions of government policy on their international student recruitment efforts. Additional case study locations in other parts of the world may further these findings. Future studies should consider how national policy shapes different types of practices also may help institutions improve performance. Previous literature shows there is little research examining the internal operations of HEIs from different jurisdictions and the lack of different actors’ perspectives on international student recruitment practice (Findlay et al., 2017; Ross et al., 2007, 2013). Expanding the research to different jurisdictions and including different institutional practices such as research and teaching may add insights into the complexity facing higher education and its practitioners as they operate in global environments.

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## Lessons learnt – The role of peer-to-peer lecture films in a first year material science laboratory course

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### **Abstract**

*At HTW Berlin material science is taught to first year students in combination with laboratory exercises on materials testing. Still, basic knowledge upon theory is necessary to work practically during lab sessions. Therefore homework reading is assigned and additionally lecture films guide students through the laboratory routine prior to class. Initially inspired by students these lecture films were conducted during a one term student semester project according to the peer-to-peer approach supervised by lecturers and film experts. Since establishing the lecture films in summer semester 2015 time consuming explanations were redundant and the students were prepared better gaining more knowledge during practical work than those who did not have access to the films. After watching the introductory films download activities increased and online lectures were prepared carefully. However, the initial increase in final test results is not valid taken into account all grades from 2015 up to now. Still, even if the academic output is not better with our without the implementation of lecture films, the better handling of laboratory equipment and the more smoothly running lab courses account for at least a part time success.*

**Keywords:** *lecture films, inverted classroom, peer to peer, material science, laboratory.*

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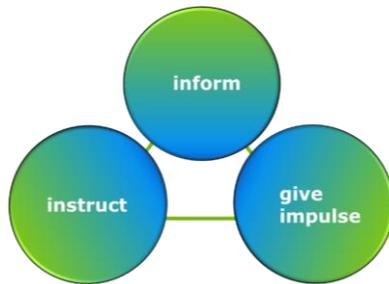
## **1. Introduction and peer-to-peer laboratory videos**

Material Science is taught to first year mechanical engineering students at HTW Berlin via the “design-led” teaching approach: Ashby (2013), Pfennig (2016-1/2), Pfennig (2018) first facing the engineering product, then introducing its properties and later relating these to microstructure, atomistic structure and progressing to the physics and chemistry of materials. Teaching goal is the understanding of material science, but moreover to educate students and prepare them for their role as a maker of things (Ashby 2013).

Students enroll into HTW applied university come from multiple different educational backgrounds, which is a benefit and a great challenge at the same time. It is necessary to study the scientific background of material properties to understand the material test results gained in the lab course. The concept follows a blended learning scenario where scientific backgrounds are self-studied via online-lectures. Discussions are encouraged, but each student is responsible for her/his own progression. Therefore a great variety of teaching material is provided via moodle: Pfennig (2016-2), Pfennig (2018).

In the blended learning setting implementing lecture videos into “inverted classroom” teaching scenarios: Berret (2012), Pfennig (2016-2), Pfennig (2018), Pfennig (2019-2) has a positive effect on self-efficacy beliefs and intrinsic motivation Thai (2017). Note, that there is a difference between audio or video recordings of lectures comprising at least 5 different techniques: Crooka (2017) and short lecture videos of relevant course material: Pfennig (2016-1). In general students rate lecture videos as easy to use and effective learning tools: Kay (2012) and place significant value on the use of videos: Gulley (2016), Kon (2015). Videos provide an audio and visual stimulus covering different learning methodologies. Presupposed the video included is analogous to the desired learning outcomes of the lecture: Al-Jandan (2015) lecture videos are definitely a reinforcement, rather than a replacement for lectures: Havergal (2015). Interpolated questions within online videos were preferred by students and may increase the learner’s engagement with the material: Rose (2016) and help to boost actual performance: Szpunar (2014).

Involving students directly into teaching activities (preparation of lecture videos) engage students in critical thinking: Colorado State University (2015), thus, producing deeper learning outcomes: Goto and Schneider (2010). As “peer-to-peer”: Ware (2015) literally means “from students for students” this concept was applied for planning and completing lecture videos at HTW Berlin according to the 3I-model: Pfennig (2016-1/2), Pfennig (2018) (figure 1). Effective operation of the lecture films is based on students` experience and their special needs when preparing for specific topics in material science. Therefore 4-6 students worked on a full concept and implementation and integration of three to six lecture films, each two to eight minutes long. The film making was supervised by the lecturer and director of photography of the HTW: Pfennig (2016-1/2), Pfennig (2019-1).

*inform, instruct, give impulse.***Information**

Short video inputs to replace the traditional frontal type of teaching basic knowledge for inverted classroom setups

**Instruction**

"How-to videos" to qualify students to work with machines/setups respectively theoretical models for quantitative or qualitative research.

**Impulse**

Short documentary videos for advanced students serve as an additional motivation and affirmation. These videos encourage the individual to critically examine his or her own views and promote cross-border collaboration.

Fig. 1. 3I Model Overview: Pfennig (2018).

5 “how-to” motion picture lecture videos (11:42 min) on materials testing and introduction to the laboratory course as well as 7 animated scientific lecture videos: Pfennig (2019-1/2) were produced to make the materials science laboratory come to life. These are integrated into micro lectures on Moodle and various teaching material: Pfennig (2018) (figure 2):

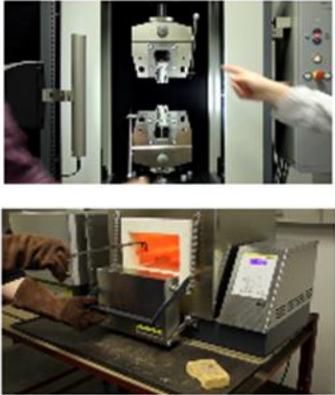
<b>Laboratory introduction</b>	Heat treatment (3:08 min)		<a href="https://www.youtube.com/playlist?list=PLUOIZMSZYzSwHG9vEu-5DWqmsktUvtx7">https://www.youtube.com/playlist?list=PLUOIZMSZYzSwHG9vEu-5DWqmsktUvtx7</a>
<b>5 films /11:42</b>	Ultrasonic testing (1:22 min)		
<b>How to video</b>	Microstructure (1:44 min)		
<b>Motion picture</b>	Tensile strength testing (1:19 min)		
	Hardness (3:09 min)		

Fig. 2. 5 “how-to” motion picture lecture videos (11:42 min) on materials testing and introduction to the laboratory course. Scientific lecture films are not openly available yet.

The material science laboratory course basically addresses first year students in mechanical engineering, economical engineering, and automotive engineering. In general students did not find it appealing to pick suiting lectures and study properly on their own when preparing for the lab course. Hence, most lab courses were very challenging, a lot of time was consumed by repeated explanations making the lab course disappointing for lecturers. The joy of hands-on courses could not be felt: Pfennig (2016-1). This research now provides broader test results and a first resume on the efficiency of “how-to” lecture videos in a first year material science laboratory course.

## 2. Course results

The concept of implementing lecture films prior to the laboratory course applied first in spring semester: Pfennig (2016-1) and overall results slightly increased (grade average in WS2014/15: 1,92 (64 students) compared to SS2015: 1,87 (84 students). Lower grades in WS2015 (1,99) are due to large differences of the results obtained from mechanical engineering (1,80) and automotive engineering students (2,17). In SS 2016 (1,58) and SS 2017 (1,50) grades were better than all previous semesters counting for both, students of mechanical and automotive engineering. Winter semester 2016/17 (1,86) and spring semester 2018 (1,83) and 2019 (1,96) showed a good average for all experiments. Winter semester 2017/18 and 2018/19 displayed the worst results since data collection. Here, the special situation of german higher education has to be taken into account with refugees entering the system. Students with migration background of these particular semester showed severe lack of language skills and therefore averagely scored significantly lower. With semesters of 65% of the students coming from Maghreb countries even lecture video supported laboratory courses did not deliver sufficiently satisfying results. It might also be possible that the outstanding results of the mechanical engineering students in winter semester 2014/15 raised the grade point average of this semester so that the results obtained by the following semesters are comparably better than figure 3 shows.

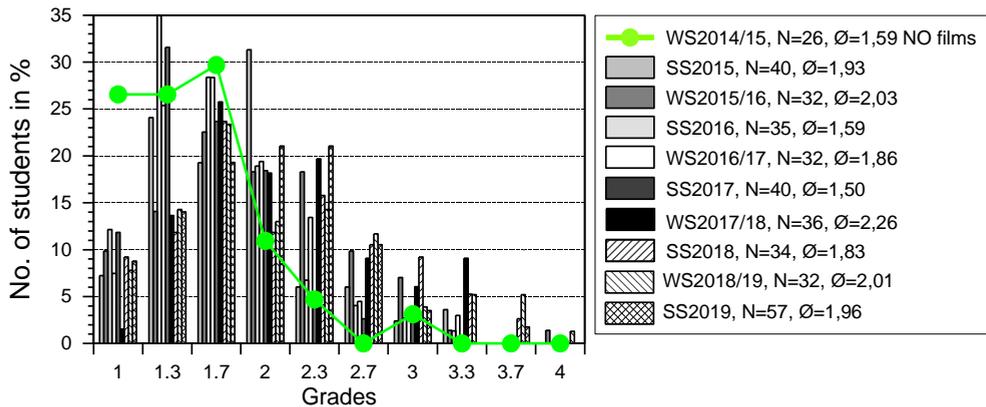


Fig. 3. Accumulated grades for 5 different experiments of students taking a lab course at HTW comparing fall semester 2014 without lecture films (green line) and all semesters from spring semester 2015 until spring semester 2019 with lecture films (histogram).

Considering every experiment of the laboratory course separately, a slight shift towards better grades after watching and working with lecture films was noticeable for the most difficult themes: ultrasonic testing and microstructural analysis. Still, there is no significant increase in grades. Although there is a shift towards lower grades since establishing lecture films as means of self-taught learning prior to laboratory classes, the number of students failing the class is very low (figure 3).

### 3. Evaluation and Discussion

Because lecture films appeal to many students, are easily accessible, repeatable and time and locally independent (figure 4) the combination of watching the films and preparing online lectures are preferred by most students. YouTube statistics show that once the students started to watch the films they completed at least 75% (figure 4).

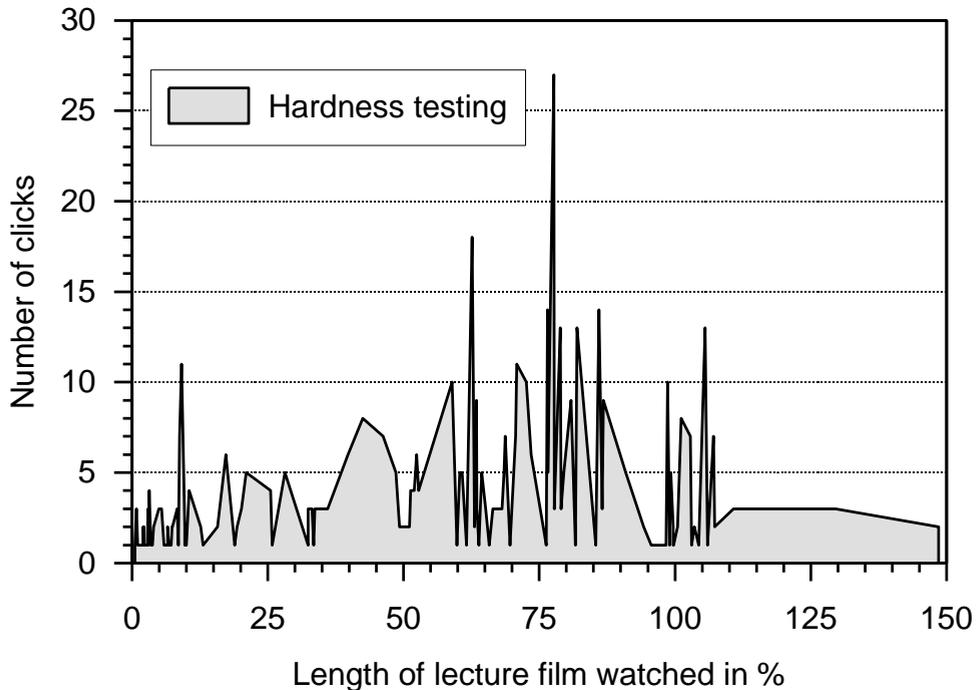


Fig. 4. Number of clicks as a function of the actual length watched in percent of the lecture film "hardness testing. Results exceeding 100% indicate the film end and titles. Most students watched more than 75% of the lecture film.

After watching the introductory films more download activity was noticed assumedly accompanied by studying of the lectures that were provided to prepare the experiments. Most students were well prepared for class, e.g. notes and handwritten summaries were brought along, mindmaps and summary sheets were downloaded and memorized. The additional learning material meant to understand the science behind the results they produced in the lab was regarded helpful. Student groups worked homogenously with lots of inspiration. They asked important questions, initiated discussions, were eager to dispose their knowledge and learn more of the details. Even those students, who did not attend the lecture classes increased their understanding of complicated correlations.

Nearly 50% of the students watched lecture films before the face-to-face laboratory lecture, and preferred films over books or online lectures because the explanation is given directly

(figure 5). However, more students state that they watched the lecture videos after face-to-face time and therefore used the videos for post-processing of the laboratory course content. Approximately 1/3 of the students state that lecture videos give an extra degree of freedom in their learning methods. Lecture videos may be used at any time provided a working internet connection helping students who have to take care of family or work. In general the combination of interactive online lectures, tests and quizzes with the lecture videos provides a highly appreciated learning environment: Pfennig (2018).

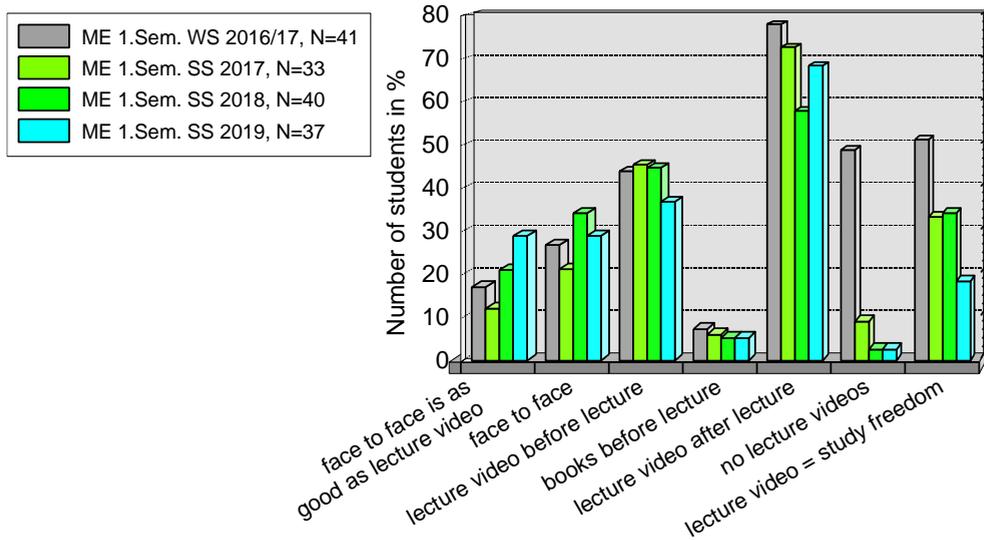


Fig. 5. Preference of lecture material in first year material science course. (multiple choices were possible)

In general, students achieved lower grades after implementation of lecture videos as means of laboratory preparation. This may be due to the “easy going” attitude towards lecture videos in the first semester. Students may have not taken lecture films as a serious method of preparing, leaving them with the feeling of being experts after watching the difficult content only once. Grades achieved in the laboratory course is directly attributed to the students` learning ability and motivation before the course. Even if not all of the lab exercises accounted for better results and the sum of all 5 experiments did not show an improvement of grades there is an increase in students` attention and individual improvement of pre-lab course test results. Course discussions are encouraged and led with a deeper understanding of the background science. Lecture films are therefore a probate media to encourage students to self-study and prepare for a laboratory course. These films therefore provide excellent requirements in these inverted laboratory classroom scenarios as shown by various authors: Berrett (2012), Pfennig (2016-2), Pfennig (2019-1), Thai (2017). However, it is assumed that students need to learn how to study using lecture videos in the first place to be accounted as

fully accepted and useful teaching media. It is therefore necessary to guide students how to use lecture films in a higher education context. Lecture films have to be worked with in a similar way as books: take your time, look for explanations of difficult words or settings and write down and summarize the essentials.

#### 4. Conclusion

The peer-to-peer approach of involving students into the implementation of teaching material in an interdisciplinary concept of teaching materials science was successfully chosen to produce lecture videos by guided student project groups. Self studying teaching material was carefully prepared to introduce 5 different materials testing experiments in a practical materials science laboratory course.

In general students rate these introductory videos as beneficial and entertaining because for most of them it is the first time working in a laboratory. After watching the lecture films as means of an inverted classroom learning scenario students knew how to work the equipment and therefore fewer mistakes occurred during the experimental procedures. They were prepared better for the questioning prior to the experiment, got involved into deeper discussions and most of them had taken serious notes improving their learning skills. Data from the course showed enhanced download activity of learning materials after watching the introductory film. However, even with an initial shift of the pre-test results to better grades with the implementation of lecture films starting summer semester 2015, the evaluation over 9 semester does not show a great benefit in terms of students' grades. Introductory videos do not automatically enhance the students' learning outcome. Moreover, this is directly attributed to the students learning ability and motivation before the course. Still, the implementation of lecture videos was assessed as beneficial in terms of knowledge upon upcoming laboratory procedures (do-s and don't-s), concentration and attentiveness as well as scientific level of communication during class.

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## **A Comparison of students' attitudes and attainment on an enterprise module for scientists and engineers**

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### ***Abstract***

*We compared data from an enterprise course aimed at scientists and engineers using the Unit Evaluation Questionnaire, coursework marks and qualitative feedback quotes with the aim of identifying any issues for embedding enterprise and entrepreneurship units in science and engineering degrees. Enterprise courses in many universities are often offered as units within other degree programmes which fulfill chartered bodies requirements for enterprise education and for employability. Whilst broadly accepted to be successful, others have reported students views on enterprise education be mixed as they feel its out of their comfort zone, and some are not open to studying units outside of their main subject, however we found student results and satisfaction to be at least as good as faculty and departmental norms. Qualitative comments suggest despite initial misgivings, they enjoy applying their subject knowledge to entrepreneurial issues and appreciate it not being a generic course. Students were not adversely affected by different assessment techniques and performed similarly to departmental/faculty averages. We found that it was key for courses to be tailored to science and engineering students such as by allowing them to study a company from their subject area for their assignments and giving science examples resulted in better engagement and feedback.*

***Keywords:*** Enterprise and Entrepreneurship Education; Science and Engineering Assessment; Interdisciplinary Teaching.

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## **1. Introduction**

Many studies have shown that enterprise education is beneficial for science and engineering students (e.g. Souitaris et al., 2007; Maresch et al., 2016) not just in the context of starting their own business or commercializing research, but also as part of an employability focus with those having participated being seen as more employable by employers (O'Leary, 2012 and 2017). The Quality Assurance Agency for Higher Education in the UK (QAA, 2018) suggests all students should have some enterprise education as part of their overall development. Embedding enterprise in the curriculum for these students has been discussed (e.g. Clements, 2011; Handscombe et al., 2008). Tradeoffs exist between efficiency issues – whether to use subject specific content for small groups of individual subject areas or use more generic courses with larger classes with the opportunity to mix with students from different backgrounds and subject areas, but where content is less tailored to subject areas. There are also a variety of activities on offer extracurricular at Universities (Papadopoulou, and Phillips, 2019 and Phillips, 2010), but some faculties and schools have decided that compulsory enterprise training is required for all students as part of their degree programmes which aligns with chartered body recommendations for degree courses.

Enterprise Education is useful for preparing students for an uncertain job market and producing high growth technology firms. Researchers also have found that Enterprise Education leads to higher Entrepreneurial Intention which is a good predictor of starting a business (Kautonen 2015, Martin et al 2013). Maresch (2016) found that Entrepreneurial Intention was raised more in business students than science and engineering suggesting this was because students who already have some business education are more likely to absorb entrepreneurship skills and knowledge. Further, it is suggested that science and engineering students can develop a social identity which rejects entrepreneurship in favour of pure science (Jungert 2013). However, it was found that an approach keeping the subject area (science and engineering) at the core of the teaching was a successful strategy for engaging students and reducing the construction of a negative social identity, in fact one study found that Entrepreneurial Intention was especially raised in electrical engineers (Duval-Couetil et al., 2012) and another in Spanish engineering students (Barba-Sánchez and Atienza-Sahuquillo, 2018). Our strategy was to use many science and engineering examples and encompass product development into the taught material and assessment, and with an applied assessment rather than an exam.

We consider a final year undergraduate enterprise course adapted for a range of science and engineering students. The course was of twelve two hour sessions, consisting of opportunity spotting and value creation, market research, basics of finance, risk management, cost control, sources of funding and growing a business. It is intended as a 10 credit unit within other subject areas (science and engineering), to address the need for graduates to be enterprising whether they start a business themselves or work in a larger organization. This

course was made compulsory for many students based on feedback from employers and experts from the Chartered Bodies that accredit each degree programme, with employers complaining of students not able to apply their knowledge immediately and requiring training which is expensive for companies to provide. Since only about 5% of students will become self-employed on graduation, courses need to be relevant for those going to work for a wide range of organisations. These units fit well with employer and alumni needs and suggestions, but short term, lecturers need to get good feedback from students and often compulsory courses outside of the main subject area get poor feedback if students cannot see the relevance and they feel it is out of their comfort zone. This problem can arise with lecturers needing good feedback, rather than maybe teaching what is needed, or not teaching for the audience but simply transposing business school courses onto science students. In terms of summative assessment, often enterprise courses have a more practical element of assessment such as reflective journals (Phillips, 2008), posters, feasibility reports, business plans, or pitch presentations. They also can involve group working and Enquiry Based Learning (Sanchez-Romaguera and Phillips, 2018). Alumni entrepreneurs have said that the more practical the courses and the assessment, the more valuable for those planning to start a business (Phillips, 2018).

For many of the students, the assessment for the unit was different to what they were used to which was primarily examination and lab work. It consisted of a 4000 word assignment whereby the student analysed the current state of a company from their own subject area using financial measures and suggested a ways the company could add further value to the company's products or services based on market research and with costing. This was part of "dealing with uncertainty", an important learning outcome of an enterprise course which students can be uncomfortable with, especially students from a subject area where a defined numerical answer is the norm. Using real data from databases, speaking to customers or companies gave a more practical and applied assignment which was hoped would appeal to students. There were also two "consultancy" sessions where students could meet with the lecturer and ask specific questions and discuss their assignment, it was hoped this would alleviate any issues students might have with the assignment by providing reassuring guidance. An important issue is not just whether entrepreneurial intention is raised, but whether students are able to adapt to the demands of different assessments and the aim of this paper is to understand any issues there might be in improving the offering so not only are outcomes achieved but students feel confident in taking entrepreneurship courses and also give good feedback which is important to teaching staff.

## **2. Methodology**

We compared students from science and engineering subject areas in four separate classes – computer science, electrical engineering, and two mixed class (chemical engineering,

mechanical engineering and biotechnology) and looked at data over a three year period from each of these classes. We used feedback from the Unit Evaluation Questionnaire from each area (filled in anonymously and electronically at the end of the course), student assignment marks and comparing with school averages where possible. We also investigated qualitative comments to further understand any issue that students felt were important for this type of course. This data collected was also anonymous giving students a chance to freely reflect their views. Class sizes ranged from 37-76 students and data was collected from the years 2016/17, 2017/18 and 2018/19. For most classes, the sessions were 2 hours per week for 12 weeks but for electrical engineers sessions they were three weeks of 4 hours per week, a three week break then a further three weeks of 4 hours per week, although no comments were made by students about lecture scheduling.

### **3. Results and Discussion**

From the qualitative comments, it is clear that the students initially had similar fears to those found by other researchers that the method of assessment was different to what they were used to, and as final year students, were worried that this might impact their marks with students commenting -

*“A 100% coursework module is very heavy, and whilst support was given from the lecturer, formal instructions and advice given about the subject at the beginning was quite brief, can be open to discussion a lot which is very risky, especially if a full 3rd year module depends on it”*

*“And could provide a guide as to how to do the assessment, what is expected of this type of work as most people have never done a piece of work to this level before.”*

We also found the phenomena that some students didn't see the relevance of doing this type of course within their degrees and there was a worry that students would revert to social norms within their subject area and reject anything new, or new ways of learning –

*“I believe for some it may have been difficult to understand why we were taking this unit and what relation it has to our degree, although this may be at the discretion of the School of EEE”*

Some didn't understand the need to apply the knowledge learned e.g. *“why are we looking at X when the assignment is about Y”* when learning how to apply models in different situations.

The marks achieved by the students seem to show however that they performed well in the assignment (Table 1) and marks were at least as good as those achieved in other units. Table 1 also shows that there is little difference between the marks obtained by students on the separate courses from Computer Science, Electrical Engineering, and mixed classes of Chemical Engineering and Biotechnology.

**Table 1: Average marks (%) and number of students on each course (in brackets)**

Subject Area	2018-19	2017-18	2016-17
Computer Science (Semester Two)	67.04 (47)	66.18 (64)	66.17 (67)
Engineering/Biotechnology (Semester One)	70.79 (56)	69.69 (42)	66.63 (44)
Engineering/Biotechnology (Semester Two)	69.69 (55)	69.41 (37)	66.35 (40)
Electronic Engineering (Semester One)	71.81 (60)	68.62 (76)	68.61 (76)

Data obtained from the Unit Evaluation Questionnaire survey at the end of the course shows above average feedback from students compared to departmental and faculty norms (Table 2). Feedback, in terms of satisfaction, was high from all classes and similar to departmental norms. Fears that science students would revert to social identity where anything different was rejected seemed unfounded. Others within the university have found that with compulsory units where students feel they are forced to do something they are not interested in some students give negative feedback automatically, however the feedback for all courses is above school and faculty average, suggesting students were happy with the course. We found also that there were no individual students that gave significant negative feedback.

**Table 2: Data shows student feedback data (marked out of 5) for each course, brackets are school average scores**

Subject Area	2018-19	2017-18	2016-17
Computer Science (Semester Two)	4.33 (4.16)	3.80 (4.09)	4.29 (4.06)
Engineering/Biotechnology (Semester One)	3.93 (4.16)	4.80 (4.09)	4.00 (4.06)
Engineering/Biotechnology (Semester Two)	4.40 (4.16)	3.93 (4.09)	4.25 (4.06)
Electronic Engineering (Semester One)	4.17 (4.16)	3.82 (4.09)	4.20 (4.06)

Qualitative comments suggest that many students in fact valued the course in terms of it being applicable to industry and were challenged positively by the different methods of assessment. Many more students commented on the usefulness of the course and appeared to understand the reasoning behind the course and what they would take away from the unit;

*“This assignment was challenging, it required having to do quite a few things I was unsure about e.g. finding the probability of a risk, what product change to choose (the cost of this, the sales of this), however due to the great feedback it was achievable and a lot simpler than I was making it for myself. Despite it being challenging, I am now really glad I did this module, as it involved a lot of analyses which I feel will come in use later on in my work*

*career. This module was good because it also helped me think about what I might like to do after university. Overall, I'm really happy with this module"*

*"A content that will actually be useful for the future. An assessment that has meaning and is enjoyable. The independence of the coursework task"*

*"Real world examples a good level for non- business students"*

*"I really enjoyed how feasible and practical the module was. -Has a good mixture between theory and practice where we can use our knowledge of the theory learned in class into our assignments"*

*"The assignments were fun, and different to anything I've done before"*

It was observed anecdotally that in each year Computer Science students had a much lower attendance than other groups, and made less use of the consultancy sessions, but those that engaged were very engaged – attending every session and consultancy, with many emails and discussions after the lectures. Some students however attended no lectures, it was found to be normal in Computer Science that some students didn't attend lectures. The computer science average results seemed slightly lower overall – although there was a broader spread of marks with some very high and very low marks. Survey showed that many computer science students prefer to work off podcasts rather than attend lectures (voice and slides podcast were available for all lectures).

#### **4. Conclusions / Discussion**

Despite initial worries from some students, that they were doing something new – that they hadn't written a report before, and often referred to the coursework as an "essay", marks were comparable to other units they were doing elsewhere. It seems that the students adapted quickly to different forms of assessment. Many students particularly valued the individual meetings and consultancy to get help on the coursework which helped bridge the gap. The students who filled in the UEQ seemed happy with the course and the teaching, despite it being compulsory for some. The feedback was similar or above the school average in most cases. Key to gaining acceptance from students seems to be to explain and show how enterprise applied to their subject, give examples from their subject area to show relevance early on. Allowing the assignment to be on a company of their choice in their subject area was helpful – they feel like its aimed at them and gives them a chance to apply knowledge from their subject area. This compares with generic enterprise courses which often get lower feedback as students don't feel like it's aimed at them. It is important to reflect on feedback previously obtained from employers and alumni entrepreneurs who value the more practical approach and allow students working in industry to apply their knowledge to problems of commercial value as soon as they begin their careers rather than be stuck in an academic

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