BLENDED LEARNING AS A RESPONSE TO STUDENT HETEROGENEITY

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Abstract:
These days the student body is characterized by a huge heterogeneity. Therefore, higher education has to cope with new demands concerning heterogeneous students. In addition to the examination of dimensions of student heterogeneity, the higher education system comprising bachelor's and master's degree is analysed. By using Spence's (1973) signalling model we compare the signalling-power of different degrees. In contrast to prior one-signal-degrees, this more differentiating system enables students to choose different levels of higher education degrees and therefore, it supports student heterogeneity. Nevertheless, a successful completion is not always achieved. Drop-out rates may be the result of wrong self-assessment, since signalling requires the knowledge of one's individual productivity. In order to implement actions in the daily teaching routine JACK as an example of blended learning is introduced as a response to wrong self-assessment and increasing heterogeneity of students. On the one hand, the implementation of JACK in courses meets the growing demands of a heterogeneous student body through guiding self-study and through flexibility of time and space. On the other hand, JACK helps to correct flawed self-assessment with the aid of immediate feedback and possibilities to repeat course contents. Consequently, this paper analyses dimensions of student heterogeneity and based on this analysis proposes blended learning as a successful measure to adapt teaching routines.

Keywords: blended learning, student heterogeneity, signalling, higher education, online learning, drop-out, self-assessment

1. INTRODUCTION

These days higher education is characterized by an increasing heterogeneity of students (Hanft, 2015). Besides traditional aspects of heterogeneity like skills, professional experiences, social and cultural background, diversity has further dimensions. New sources of heterogeneity are represented by a high age span and by differences in organizing self-study (Schulmeister et al., 2012). The homogeneous university structures, teaching methods and courses with a huge numbers of students are confronted with these heterogeneous student characteristics. Thus, higher education has to cope with new demands concerning student heterogeneity. Until now initiated actions like receiving inspections and preparatory courses concentrate mainly on the start of higher education studies and do not take teaching routines into account (Hanft, 2015). Instead of transforming heterogeneity into homogeneity, higher education might be forced to adapt course structures in order to accept heterogeneous students (Biggs & Tang, 2011, Wildt, 2001).

Furthermore, the choice between differentiated higher education degrees is a possibility to pay attention to heterogeneous students. Within the framework of the Bologna process the higher education system has been restructured to bachelor's and master's degree (EACEA, 2012). In contrast to prior degrees like the Diplom in Germany, this highly differentiating system enables students to choose different levels of higher education degrees according to their cognitive abilities and commitment level.

In this connection, the completed degree serves as a signal for the employer, which reduces his uncertainty concerning the productivity of the graduate (Spence, 1973). In order to compare the signalling-power of different degrees we compare a one-signal-degree and the bachelor's and master's degree as a two-signal-degree by using Spence's (1973) signalling model.

Spence's signalling model assumes students to be perfectly informed about their skills, but in reality a successful graduation is not always achieved. Although the choice of bachelor's and master's degrees gives individuals differentiated possibilities of education, many students drop-out. According to the results of the research of ``OECD-Education at glance'' (OECD, 2013) and ``Bologna Process Implementation Report'' (EACEA, 2012) only 70% of students graduate among OECD countries. This drop-out rate may be the result of wrong self-assessment.

With the aim of accepting student heterogeneity and improving flawed self-assessment, higher education should give more attention to the adaptation of course structures instead of concentrating mainly on the start of higher education studies. In order to implement actions in the daily teaching routine blended learning might be a response to the wrong self-assessment and increasing heterogeneity of students.

Thereby, blended learning combines traditional face-to-face sessions and online learning opportunities which are available around-the-clock. E-learning tools are characterized by a high flexibility of time and space, they help to organize the self-study and deliver immediate feedback. Besides these advantages of blended learning, the current learning environment shows a trend towards online learning. Many surveys emphasize that online learning tools have increased significantly in students' learning experiences (Allen & Seaman, 2006) and that students show a new attitude towards online learning (Sebastianelli & Tamimi, 2011).

Therefore, we analyse dimensions of student heterogeneity and show how blended learning pays attention to these dimensions and improves flawed self-assessment.

2. STUDENT HETEROGENEITY

Multiple reasons lead to the growing heterogeneity nowadays.

The first reason is caused by the increasing number of first-year students. Over the past 16 years the number of graduates has increased by nearly 20 percentage points on average across OECD countries (OECD, 2013).

Secondly, universities are open to all social classes. Thus, these days, higher education studies are not reserved to an elite anymore (Middendorf, 2015).

Furthermore, the student body shows an increasing age span and differences in previous experiences, skills, motivation, goals and social background. In this context, some policy changes in Germany lead to younger first-year students, while changing living conditions lead to older students. Moreover, many students are gainfully employed during their studies or work before or between bachelor's and master's degree (Hanft, 2015). This additional workload may lead to a postponed graduation and advanced age. Beside the increased number of students, the share of international students has expanded in particular (Alauddin & Ashman, 2014). This trend is confirmed by the OECD Indicators (2015) who emphasize that among OECD-countries international students describe a significant share of higher education graduates. Thereby, 18% of students who attained a master's degree and 7% who attained a bachelor's degree are international students. The internationalization of higher education entails a highly diverse cultural background with individual differences in the philosophy of learning (Johnson & Kumar, 2010).

Besides traditional aspects like cultural and social background, skills and professional experience, diversity has further dimensions. Schulmeister et al. (2012) emphasize a different learning behaviour among students as new source of heterogeneity. Especially, the time spent on the self-study is characterized by a huge diversity among students.

As we have seen, student heterogeneity comprises many dimensions that require new actions.

In this context Wildt (2001) distinguishes two dimensions of measures. On the one hand, heterogeneity may be accepted. On the other hand, heterogeneity may be transformed into homogeneity through receiving inspections. As described above higher education focusses on transforming heterogeneity into homogeneity until now. However, the first dimension which is represented by accepting heterogeneity may be given more priority to. This point of view is also supported by Bigg and Tang (2011), who argue that university teaching should be adapted to the needs of an increasingly heterogeneous student body.

3. SIGNALLING MECHANISM IN HIGHER EDUCATION

3.1. Signals in higher education

In 1973 Michael Spence first introduced the effects of signalling on the job market. Since asymmetrical information prevail on the job market, the employer does not know the productivity of the individual before hiring him. Therefore, this is a decision under uncertainty. In order to counteract this uncertainty individuals have the opportunity to invest in education, which involves costs in terms of money and time. Obtaining a degree serves as an observable signal for the employer. Therefore, in this context education can be an efficient signal to reduce asymmetrical information.

In order to analyse different higher education degrees and its signalling-power we extend Spence's signalling-model introducing a third level of productivity. Since, these days higher education is characterized by a differentiated system of degrees comprising bachelor's and master's degrees, we need two signals instead of only one signal in case of prior degrees. In order to emphasize the signalling-power of the bachelor's and master's degree in contrast to the signalling-power of the Diplom as a one-signal-example, we use a numerical example.

We assume three groups of individuals with different productivity level. Individuals of Group 1 (low productive) have a productivity of $\theta_l = 1$ and signalling costs of $c_l = y$, individuals of Group 2 (mid productive) are characterized by a level of productivity of $\theta_m = 2$ and signalling costs of $c_m = \frac{y}{2}$ and finally, individuals of Group 3 (high productive) show a level of productivity of $\theta_h = 3$ and signalling costs of $c_h = \frac{y}{3}$. Population shares of the three groups are given by: q_l, q_m and $q_h = 1 - q_l - q_m$.

In case of Bologna which includes bachelor's and master's degree, the employer believes that two critical levels of education y^B and y^M exist, which distinguish high, mid and low productive individuals. Consequently, if $y < y^B$ productivity equals 1, if $y^B \leq y < y^M$ productivity equals 2 and if $y \geq y^M$ productivity equals 3.

In this case, only three plausible values of y exist: $y = 0$, $y = y^B$ and $y = y^M$.

In a signalling equilibrium individuals of Group 1 set $y = 0$ if

$$1 \geq 2 - y^B$$

Individuals of Group 2 set $y = y^B$ if

$$1 \leq 2 - \frac{y^B}{2}$$

Finally, individuals of Group 3 set $y = y^M$ if

$$2 - \frac{y^B}{3} \leq 3 - \frac{y^M}{3}$$

Consequently, the critical levels of education are given by

$$y^B = 1 \ and \ y^M = 3.$$

These education levels do not reflect academic years but required effort and difficulty of the degree. In contrast to the bachelor's degree which implies three years of studies and the acquisition of basic knowledge, the master's degree includes two years of additional studies and the learning of more challenging and demanding knowledge. Consequently, a master's degree includes more effort.

The firm pays a wage which equals the individual and respectively expected productivity, since it is the contribution of the graduate to the firm. Utility which is calculated by the difference between wage and signalling-costs is given by

$$u_l = 1; \ u_m = 2 - \frac{1}{2} = 1.5, \ u_h = 3 - \frac{3}{3} = 2.$$

A signalling equilibrium is characterized by a high heterogeneity of graduates with bachelor's degree and a low heterogeneity among graduates with master's degree.

In addition to this signalling equilibrium, there are three possible scenarios in case of a one-signal-degree like the Diplom: Every group signals, Group 2 and Group 3 signal and Group 3 signals.

The first scenario is not taken into account, because individuals distinguish themselves by degrees.

The second scenario can be neglected, since descriptive statistics prove that graduates with a Diplom as degree earn on average 7200 Euro more per year than graduates with a bachelor's degree (Briedis & Minks, 2005). This wage differential among graduates indicates a higher productivity among Diplom graduates in contrast to Bachelor's graduates.

In order to illustrate the derived outcomes we introduce examples for a particular case and calculate the critical level of education and individual utility for a one-signal and a two-signal-degree.

For this purpose, we apply the results of the survey ``OECD-Education at glance'' (2015). According to this survey an average of 36% of people received a bachelor's degree, while about 17% received a master's degree among OECD countries in 2013. Since, we assume that high productive individuals are able to complete the master's degree and mid productive individuals the bachelor's degree and for reasons of simplicity, we assume the following population-shares: $q_l = 0.5$, $q_m = 0.4$, $q_h = 0.1$.

Furthermore, among OECD countries people with a higher education degree are characterized by an advantage in earnings. Thereby, higher education graduates can expect to earn 60 % more than people with non-tertiary education (OECD, 2015). In addition, according to the salary survey of the National Association of Colleges and Employers (NACE, 2013) starting salaries of master's graduates in many career areas are about 20% higher than starting salaries of bachelor's graduates.

Since wage is equal to productivity, we assume that low productive individuals are characterized by a productivity of $\theta_l = 1$, mid productive individuals of $\theta_m = 1.6$ and high productive individuals of $\theta_h = 1.9$, in order to take wage differentials into account.

In the case of a signalling equilibrium with two signals representing bachelor's and master's degree, individuals have to invest

$$y^B = 0.6 \ \ and \ \ y^M = 1.2$$

and utility is given by

$$u_l = 1; \ u_m = 1.3; \ u_h = 1.5.$$

In the case of only one signal, when high productive individuals invest in education, the critical education level and utility are given by

$$y = 1.26; \ u_l = u_m = 1.27; \ u_h = 1.48.$$

Table 1: Results for $q_l = 0.5$, $q_m = 0.4$, $q_h = 0.1$, $\theta_l = 1$, $\theta_m = 1.6$, $\theta_h = 1.9$, $c_l = y$, $c_m = \frac{y}{2}$, $c_h = \frac{y}{3}$

	y	y^B	y^M	u_l	u_m	u_h
BA/MA	-	0.6	1.2	1	1.3	1.5
DIPLOM	1.26	-	-	1.27	1.27	1.48

In the case of a signalling equilibrium with bachelor's and master's graduates high and mid productive individuals benefit, while low productive individuals are disadvantaged in comparison to the one-signal equilibrium. Since low productive individuals are payed according to their productivity instead of the mean-productivity, they lose. In contrast to this, mid productive individuals have the possibility to distinguish themselves through a bachelor's degree and thus, they are able to obtain a greater wage. High productive individuals have to invest less in education in the case of a master's degree. Consequently, every group is paid according to their productivity. In the case of a Diplom high productive individuals have to put a distance between themselves and low and mid productive individuals. Therefore, the critical level of education has to be greater. In addition, because of the mean wage low productive individuals earn more and mid productive individuals earn less than they contribute to the firm. Consequently, the bachelor's and master's degree leads to an improvement for high and mid productive individuals and to a deterioration for low productive individuals.

We are able to emphasize that a system with two signals is much more suitable to reduce asymmetrical information in comparison to a system with only one signal.

3.2. Flawed self-assessment

Although the bachelor's and master's system enables individuals to choose an adequate degree, a successful graduation is not guaranteed. According to the results of the research of ``OECD-Education at glance'' (OECD, 2013) and ``Bologna Process Implementation Report'' (EACEA, 2012) only 70% of students graduate among OECD countries. These students who do not complete their studies are described by drop-out.

The individual self-perception of ability might be a reason why university requirements and perceived knowledge do not fit and therefore, cause notable drop-out. We focus on flawed self-perception as reason for drop-out. Self-perception of ability plays a crucial role in the decision to invest in higher education, the choice of degree and the probability of graduation.

A wide range of literature examines students' self-perception and its impact on their studies. In this context, Chevalier et al. (2009) who investigate the impact of students' self-perception on participation rates in higher education, find out that students misconceive their own performance and especially over-estimate their own ability. Thereby, a high self-perception supports the decision to attend higher education.

Dunning et al. (2004) propose feedback as an opportunity to improve pupil's self-assessment and check newly acquired contents, since feedback helps students to evaluate their own performance.

In addition, quantitative self-assessment studies that compare self- and teacher grades in higher education show that correlation between these grades is higher in advanced classes in contrast to introductory classes (Falchikov & Bound, 1989). If we interpret the correlation of grades as a measure of correct self-perception, experience has a positive influence on self-assessment. Consequently, in contrast to students of introductory classes, students of advanced classes are able to self-assess themselves more precisely.

On the one hand, an extended offer of opportunities to repeat course contents might help students to acquire experiences in solving exercises. On the other hand, feedback may be another solution to correct and to check students' self-assessment.

4. JACK AS A NEW RESPONSE

In this section we focus on the courses in microeconomics at the University of Duisburg-Essen which are characterized by a huge number of students. These courses use JACK as a measures of online support. JACK was developed and is provided by PALUNO (The Ruhr Institute for Software Technology) and represents a computer aided system offering online exercises and their automatical assessment and grading (Goedicke et al., 2008).

Besides offering weekly lectures and tutorial classes as usual, JACK as e-learning setting is implemented. While, weekly lectures and tutorial classes aim to teach basic knowledge and demonstrate examples, the e-learning opportunities offered by JACK represent a possibility of around-the-clock self-training and assessment of course contents. Thereby, online exercises guide the self-study and mid-term tests entail the possibility to improve the final exam grade. Since the courses in microeconomics combine face-to-face sessions and e-learning opportunities, blended learning is applied.

In consideration of the dimensions of student heterogeneity and with regard to flawed self-assessment, we now emphasize the contribution of JACK.

The increasing number of first-year-students leads to courses which are visited by a huge number of students. Therefore, teachers are not able to guide students individually. JACK has the possibility to pay attention to every student, by offering a huge number of exercises and individual, immediate feedback.

Since universities are open to all social classes, financing of higher education represents a burden for students of low-income families. In this connection e-learning offers a variety of learning opportunities which are free of charge.

Furthermore, many students are gainfully employed during their studies and show differences in the organization of their daily life. Since online exercises are available around-the-clock and can be solved everywhere, they offer a high flexibility of time and place. This flexibility enables students to learn according to their individual preferences of time. These aspects are also means to pay attention to international students with different cultural background.

In addition, diversity of individual learning behaviour and especially the organization of self-study is described as a new source of student heterogeneity. Applying JACK, students start solving exercises at the beginning of the semester and maintain this effort on self-study during the whole semester, instead of learning mainly at the end of the semester before the final exam. Thus, the possibility to learn around-the-clock represents an incentive to learn regularly during the semester. Thereby, the mid-term test serves as an incentive to early learning and boost the motivation to invest time in self-study.

Section 2 demands new measures to respond to student heterogeneity by accepting heterogeneity. The described gains of JACK proof that the adaptation of traditional courses to blended learning courses pays attention to student heterogeneity.

Finally, JACK may be a solution to correct flawed self-assessment, since it offers a wide range of opportunities of repetition and feedback on a regular basis. In order to improve the retention of taught contents, students have the possibility to repeat course contents by solving as much exercises as they want and need to. These possibilities of repetition support the acquisition of experience in solving exercises. Furthermore, every time students hand in a solution, it is evaluated and a response is given immediately. In addition, mid-term tests assess the level of skills and give information about the learning progress. Therefore, students who obtain feedback through JACK are able to check their self-assessment and adapt learning activity according to the received feedback.

5. CONCLUSION

Nowadays, the student body is characterized by huge heterogeneity. Since until now initiated measures concentrate mainly on the opening phase of higher education, they only aim to make heterogeneous students fit to homogenous university structures.

Furthermore, higher education system offers differentiated degrees like the bachelor's and master's degree, which enable students to choose a degree according to their skills and future plans.

Contrasting the predominant higher education system comprising bachelor's and master's degrees with prior one-signal degrees, we show that mid and high productive individuals benefit and low productive individuals are disadvantaged. While mid and high productive individuals are able to graduate with an advanced degree and earn higher wages, low productive individuals do not gain an advantage from a mean-wage. Compared to a one-signal degree high productive individuals have to invest less in education, since they do not have to put a distance between themselves and low and mid productive individuals. Moreover, mid productive individuals have the chance to complete an intermediate degree and are able to distinguish themselves from low productive individuals.

Consequently, the higher education system meets the needs of heterogeneous students. Nevertheless, the signalling model assumes students to be perfectly informed about their skills. But in reality drop-out rates prove that students do not always complete their studies. One main reason for drop-out might be flawed self-assessment. Individual self-perception of skills plays a crucial role in investing in higher education, the choice of degree and a successful graduation.

In order to take heterogeneity into account and to improve flawed self-assessment, we propose blended learning as a new measure improving teaching routines.

As an example of blended learning we introduce the online learning tool JACK, which supports traditional face-to-face sessions.

The around-the-clock offer of online exercises provides individual feedback, flexibility of time and space and pays attention to the individual learning progress of every student. Therefore, online exercises consider different living conditions, learning preferences and social and cultural background and guide students' self-study. By introducing online mid-term tests students' motivation to repeat course contents from the beginning of the semester is enhanced and they receive a feedback which evaluates acquired skills. These effects improve flawed self-assessment, retention of newly acquired skills and regularity of learning during the semester. These online learning tools enable students to learn according to their individual preferences and backgrounds and their self-study is guided during the semester.

Concluding, we are able to emphasize that the implementation of blended learning to university courses meets the growing expectations and needs of heterogeneous students and improves self-assessment.

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