

Attitudes Towards a Moodle-based E-Learning Platform: A User Segmentation Perspective

Full Paper

Mariusz Grabowski

Department of Computational Systems
Cracow University of Economics
Mariusz.Grabowski@uek.krakow.pl

Adam Sagan

Department of Market Analysis and
Marketing Research
Cracow University of Economics
Adam.Sagan@uek.krakow.pl

Abstract

The paper objective is to apply Technology Acceptance Model (TAM)-based usage and attitude variables for the predictive user segmentation of Moodle-based e-learning system in a university. The study explores the path models with latent variables estimated by partial least squares method (SmartPLS and plsmpm library of the R package were used for the parameter estimation) and uses the mixture models (FIMIX and REBUS) for model-based segmentation. Modified technology acceptance model (TAM) was estimated on the sample of 204 students of the Cracow University of Economics. As a result of segmentation analysis, 3 segments of “easiness seekers”, “emotionals” and “loyals” were identified and profiled.

Keywords

Moodle, TAM, PLS-PM, clustering.

Introduction

E-learning is becoming widely available due to highly developed information and communication technologies (ICT) in the area of the Internet, browsers and mobile solutions. It is implemented through many forms and/or extended functionalities such as CMS (Course Management System), LMS (Learning Management System), VLE (Virtual Language Environment) and MOOC (Massive Open Online Courses). E-learning corresponds with the centric role of the learner who can regulate the pace, time and place of the learning process. Its advantages include cost effectiveness, availability to global audience, an unlimited access to knowledge, re-use of training material, archiving and sharing functionalities. The disadvantages come from the lack of immediate feedback, increased effort in preparation of the materials, uncomfortable way of interaction for some people which may cause frustration or confusion (Zhang et al., 2004, p. 76).

E-learning platforms offer their services through various technologies (local or cloud-based) and licensing models (paid or free). Blackboard/WebCT is one of the most frequently used proprietary platform, whereas Moodle (Modular Object-Oriented Dynamic Learning Environment) is the most often deployed system that uses free and open-source GNU/GPL licensing model (Costa, et al., 2012). The cost-free licensing together with rich functionality led to a high popularity of Moodle. As this paper was being written (beginning of 2016), there were over 67 thousand active sites in 222 countries with over 80 million registered users (<https://moodle.net/stats/>). Moodle owes its popularity to the software openness, licensing gratuitousness and rich functionality, modularity and standard compliance of its system design. The above arguments position Moodle as an interesting e-learning platform for universities.

The paper presents the results of TAM-based research on the structure of attitudes toward a Moodle-based e-learning system conducted among IT/IS (business information systems) students at Cracow University of Economics (CUE), Krakow, Poland, where e-learning is combined with other teaching methods. As TAM assumes the homogeneity of population under study while the student population is diverse, the authors added a new perspective by analyzing the group-structure of the population. Also, a new construct -- Behavioral Intention Toward Future Use (BIFU) has been added to the original TAM in order to distinguish between service-process and service-outcome concepts. Such distinction is utilized in marketing studies (Dabholkar and Overby, 2005).

The paper begins with defining the e-learning system within the socio-technical theory and laying ground for the user perspective-based assessment. Then the literature overview of e-learning assessment is provided while indicating TAM as a valid method for e-learning assessments. The second chapter presents the research assumptions, modifications to TAM and questions asked to the users. The obtained results are discussed in the third chapter, which consists of three sections. The first section discusses model estimation on the total sample while the second and third are devoted to classification issues. The conclusion section summarizes the key achievements and outlines considerations for future research.

E-learning Quality Assessment

There seems to be no effective and generally accepted quality assessment method of e-learning as much as there is no single definition of e-learning or its quality standard. E-learning can be understood, following Upadhaya and Mallik (2013), as the socio-technical system where (1) social – concerns the attributes of people including their attitudes, skills, values, relationships and organizational structures, and (2) technical – consists in processes, tasks, and technology needed to transform inputs to outputs. The output is a product of the constant interaction between these two components. The authors would like to stress that e-learning is not limited to technological dimension only. The quality of e-learning may be assessed only in the relationship to the people who interact with it (learners and instructors) and the organization that creates the environment for learning process.

The quality of e-learning process is not a well-defined category as it relates to various perspectives (Penna and Stara, n.d.). In this paper, it is defined in terms of a learner satisfaction.¹ The literature analysis conducted by Grabowski (2015) allows to distinguish three categories of methods for e-learning quality assessment: theory-based, institutional-based and standard-based. The theory-based category, which is predominant within scholarly literature, includes social cognitive theory (SCT) or TAM measurement model as the main theoretical concepts. The main concepts could be then extended by other constructs or theories. It appears that SCT has never been exclusively and it was extended by adaptive structuration theory (Gupta and Bostrom, 2012) and self-efficacy (Santhanam, et al., 2008). In case of TAM (which is dominating within theory-based category), the analyzed studies (1) use TAM in an original form (Capece and Campisi, 2013; Kim et al, 2013; Tselios, Daskalakis, and Papadopoulo, 2011), (2) extend TAM by other constructs such as perceived enjoyment (Cheng, 2011), performance (Buche, Davis and Vician, 2012), perceived enjoyment, perceived learning and recommendation for use (Wu, Hiltz and Biber, 2010), and communicativeness, format, user adaptation, feedback, methodology, diffusion, user tools, enjoyment, reliability, accessibility, interactivity and control (Martinez-Torrez et al, 2008), and/or (3) supplement TAM by additional theories, i.e. self-efficacy theory (Cheng, 2011; Martinez-Torrez et al, 2008; Read and Leavy 2008), expectation-confirmation theory (Islam, 2011), SERVQUAL and organizational learning (Wong and Huang, 2010), perceived innovation attributes (Liao and Liu, 2012) and usability and media richness theory (Wu and Hwang, 2010).

¹ P.-C. Sun et al (2008) identified 6 quality dimensions (learner, instructor, course, technology, design and environmental) and 13 factors across these dimensions influencing the learner satisfaction. Their study indicated that the most critical factors are: learner computer anxiety, instructor attitude towards e-Learning, e-Learning course flexibility, e-Learning course quality, perceived usefulness, perceived ease of use and diversity in assessments.

This study extends original TAM by an additional construct and introduces covariates aimed at profiling the segments of users. It is in line with prior research studies on the e-learning acceptance in general (Cheng, 2011; Liao and Liu 2012; Wu, Hiltz and Bieber 2010) and Moodle in particular (Arteaga Sanchez and Duarte Hueros, 2010; Escobar-Rodriguez and Monge-Lozano, 2012). The main objective of the study is to explain the overall factors shaping behavioral intention to use and an actual system use of Moodle platform among the students and identify segments of students on the basis of estimated model. The following research questions are proposed: 1) What factors explain the behavioral intention to use and the actual system use of Moodle platform, 2) What type of mediation effects explain the relation between focal predictors and outcome variable, 3) What are most sensitive criteria of predictive segments of students on the basis of model parameters, and 4) Which characteristics of the students contribute mostly to differentiation of the segments.

Research Model

TAM (Davis, 1989; Davis, Bagozzi and Warshaw 1989) and its derivatives, e.g. UTAUT (Unified Theory of Acceptance and Use of Technology) (Venkatesh et al. 2003) belong to the most frequently used theoretical frameworks to interpret behavior of users with regard to IT/IS artifacts and their acceptance. Its theoretical foundations are acquired from the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975) and the Theory of Planned Behavior (TPB) (Ajzen, 1985). In the light TPB, the behavioral intention is shaped by three mutually conditioning factors: an attitude toward the behavior, a subjective norm, and a perceived behavioral control. In TAM, the actual system use is directly determined by behavioral intention to use. This intention, however, is formed directly by the attitude toward using and perceived usefulness and indirectly through perceived ease of use. Perceived ease of use and perceived usefulness may be influenced by additional external variables. The usage attitudes toward IT/IS artifacts have evolved over the time. Today IT/IS users apply the new software in a more trial-and-error manner than formulate firm expectations before the first system usage. This, in our opinion, in a great degree concerns the students which are fascinated with modern technology. For this reason, we decided to modify original TAM by adding a construct reflecting the result of experimental system usage: behavioral intention toward future use constituting the focal outcome variable of the model (Figure 1).

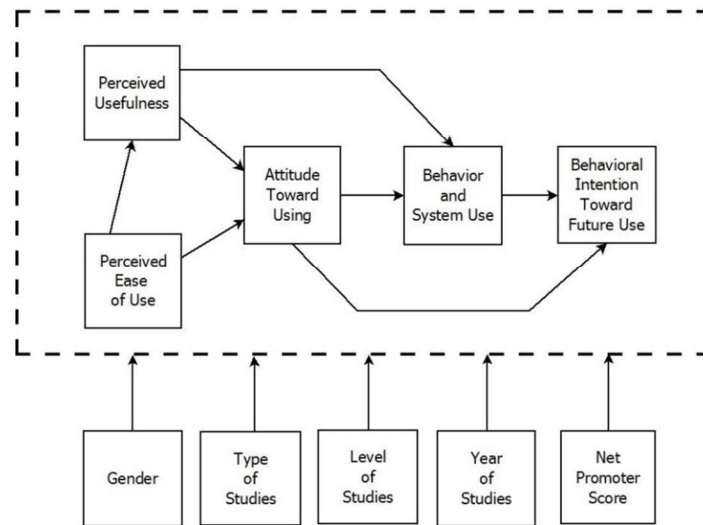


Figure 1. Research Model

E-learning may be perceived as a long term continuous service provided by CUE platform, thus the cognitive response toward the service consists of two dimensions: 1) buying intentions toward the service-as-a-process and 2) buying intentions toward the new service episodes (Dabholkar and Overby, 2005). Introducing this new variable helps differentiate between the behavioral intention to use, which is considered as *ex ante* or service-as-a-process construct and the behavioral intention toward future use

considered as *ex post* or service-outcome construct. The behavioral intention toward future use is determined by behavior and system use (linking two constructs from original TAM, i.e. actual system use and behavioral intention to use) which all combined serve as mediators with relation to perceived usefulness and perceived ease of use.

In order to get an insight into the structure of users, five covariates aimed at profiling the segments have been added to the model. As portrayed in Figure 1, they influence the entire model rather than its specific variables. The covariates include: gender, type of studies (i.e. full-time or part-time), level of studies (i.e. undergraduate or graduate), year of studies (i.e. 1-3 for undergraduate or 1-2 for graduate) and, net promoter score (NPS), indicator known from marketing research. NPS is a loyalty index based on question concerning recommendation of product on 0-10 scale. The difference between 0-6 fraction and 9-10 fraction of responses gives the NPS index (positive or negative). The constructs and indicators (measured on 5-point Likert scale) used in the survey of 204 selected respondents (users of e-Platform at CUE) are presented in Table 1.

Variables	Constructs and items
PEOU	Perceived Ease of Use
PEOU1	e-Platform is easy to use
PEOU2	e-Platform is an easy tool for achieving learning objectives
PEOU3	e-Platform is easy to mastering the material
PEOU4	e-Platform is easy to understand
PEOU5	e-Platform CUE is readily available
PU	Perceived Usefulness
PU1	e-Platform allows to learn more effectively
PU2	e-Platform allows to learn in a faster way
PU3	e-Platform allows greater control over the learning process
PU4	e-Platform allows to save learning time
PU5	e-Platform allows for significant advancement of knowledge
A	Attitude Toward Using
A1	e-Platform is an attractive method of learning
A2	e-Platform is an improvement for the educational process
A3	e-Platform satisfies my needs for e-learning
A4	I like to use e-Platform
BU	Behavior and System Use
BU1	I use e-Platform to prepare for the exam session
BU2	I am using e-Platform on daily basis
BU3	I am using e-Platform whenever I have a problem to solve
BU4	I am using e-Platform because I can do it at any time
BIFU	Behavioral Intention Toward Future Use
BIFU1	I intend to use e-Platform regularly
BIFU2	I will also use e-Platform in the future
BIFU3	Using e-Platform is a daily necessity
BIFU4	e-Platform constitute a future for learning process at CUE

Table 1. Variables used in the study

Discussion of Results

Model Estimation on Total Sample

All students from all types, levels and years of studies were asked to fill out a noncompulsory questionnaire (Table 1). As a result, 204 responses were obtained which constitute 25.2% of the total enrolled students (809). The distribution of responses in respective student segments (i.e. full time / part time and graduate / postgraduate) ranged from 13.1%-26.2% which may be supposed as acceptable for such studies. TAM-based research model was estimated using partial least square path model with latent variables (PLS-PM). This method of estimation belongs to the family of “soft” and predictive structural

equation models that are especially popular in IT/IS area (Chin, 1998; Chin et al. 2003) and marketing research in the area of analysis of the relationships between attitudes and behavior (A-B problem) and satisfaction and loyalty (S-L problem) (Fornell and Bookstein, 1982; Lohmoller, 1989; Hair, et al. 2014). Indicators of the latent variables can be treated as reflective or formative in PLS-PM model. In our model all of the scale items are regarded as reflective indicators of the latent variables. The mode A was selected as the method of outer model weighting and for inner model the path weighting was used.

Figure 2 depicts the estimated inner (structural) and outer (measurement) model.

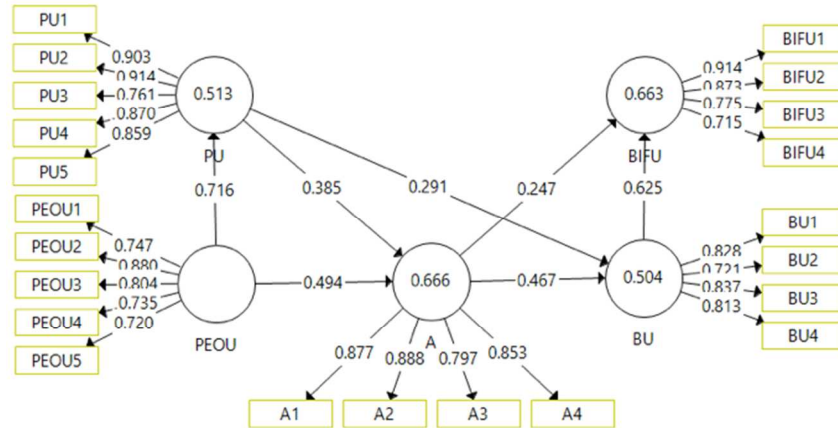


Figure 2. Research model with latent variables on total sample

The structural parameters reveal significant and positive relationships between the constructs. Perceived ease of use (PEOU) has a strong and positive relation with perceived usefulness (PU) and the latter variables have a significant mediator effect with respect to PEOU - A relationship. The focal outcome variable that is a behavioral intention toward future use (BIFU) depends mainly on behavior and system use (BU). Analysis of mediation effects (Table 2) shows that model mediators (PU, A, BU) sufficiently explain the relationship between predictors and dependent variables.

Relationships	Direct	Indirect	Total
PEOU – A	0.494	0.276	0.770
PU – BU	0.293	0.181	0.474
A – BIFU	0.263	0.268	0.549

Table 2. Mediator effects between predictors and outcome variables

The goodness of fit indexes of the structural model is presented in Table 3.

Latent	R ²	Block	Mean	AVE	Composite	Cronbach's
PEOU	0.00	0.61	0.00	0.61	0.89	0.84
PU	0.51	0.74	0.38	0.74	0.94	0.91
A	0.67	0.73	0.49	0.73	0.91	0.88
BU	0.51	0.64	0.33	0.64	0.88	0.81
BIFU	0.66	0.68	0.45	0.68	0.89	0.84
SMRM	0.08					
GoF	0.63					

Table 3. Goodness of fit measures

The overall goodness of fit is near an acceptable level (0.63) and the coefficients of determination (adjusted R²) are relatively high. Also communality and redundancy measures show that dependent manifest and latent variables are sufficiently explained by set of predictors.

Identification of The Number of Segments

In segmentation of the Moodle users on the basis of research model, both the FIMIX-PLS and REBUS approach were adopted. The promising development of PLS-PM modeling for heterogeneous population is a predictive segmentation based on mixture regression and segmentation on the basis of path coefficients. The first method is model-based finite-mixture approach that enables the selection of the appropriate number of segments using information criteria (AIC, BIC) (Hair, et al., 2014; Ringle et al., 2010, 2014). The second method of segmentation is response-based segmentation (REBUS). This technique for estimation PLS-PM models in heterogeneous population uses the closeness measure between units and models based on residuals of inner and outer model (Vinzi et al., 2014).

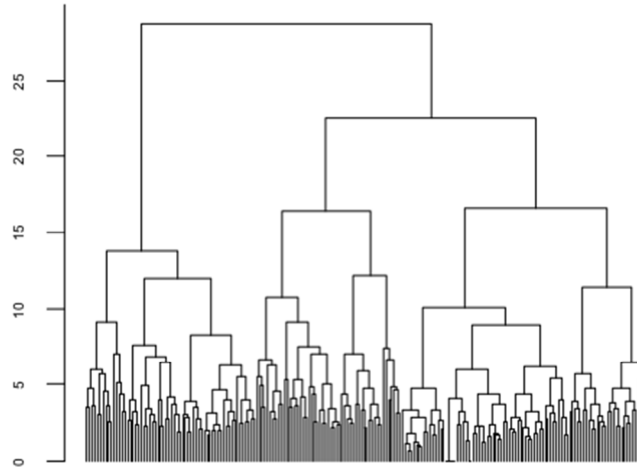


Figure 3. Dendrogram of inner and outer model residuals

The number of segments is identified on the basis of hierarchical cluster analysis on outer and inner residuals. The Figure 3 represents the dendrogram of the outer and inner residuals of TAM model.

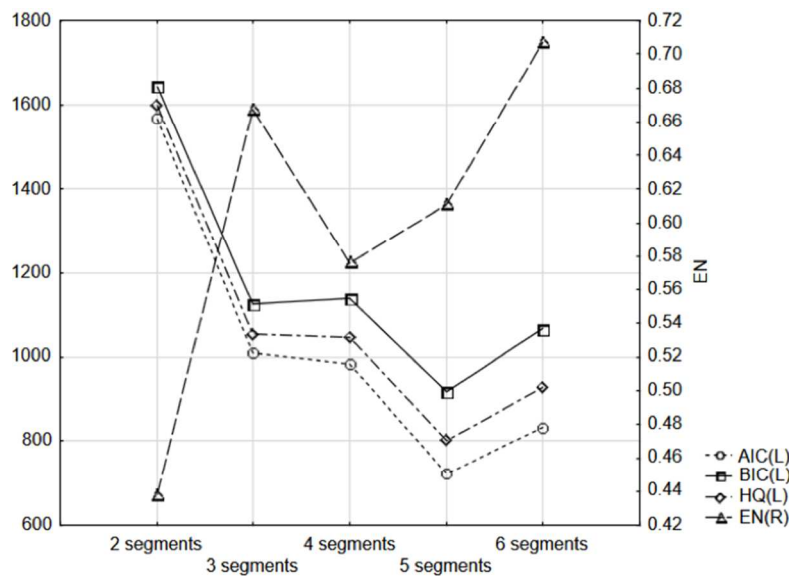


Figure 4. Plot of cluster selection criteria

The analysis of dendrogram shows that approximately 3 clusters can be extracted for further analysis. In FIMIX-PLS model the number of clusters stem from the analysis of several information and entropy

criteria. SmartPLS provides numerous criteria of form model selection. The AIC, BIC, Hannan Quinn Criterion (HQ) and Entropy Statistic (EN) were used for the evaluation of clusters. The Figure 4 shows the screen plot of information criteria. The results confirm the solution obtained by REBUS. The overall criteria suggest 3-cluster or 5-cluster solution. Because of limited sample size (204) respondents, the five cluster solution seems to be very unstable in FIMIX approach and yield highly uneven structure of segments. Therefore, the 3-clusters were selected for subsequent analysis. Model-based Moodle Users Segmentation

The profiles of Moodle users in 3-segment solution were identified using TAM model parameters. As it is shown in Table 4, the structure of the parameters is different with respect to method of segment extraction. REBUS and FIMIX segmentation give approximately similar parameters across cluster for PEOU-PU, PEOU-A, PU-A and BU-BIFU relations. The sufficient differences (for class 1 and class 3 especially) exist with respect to relation A-BU and A-BIFU. Having in mind the more balanced and stable REBUS clusters, the conclusions concerning segment profiles are given predominantly on the basis of this solution.

Paths	Easiness seekers		Emotionals		Loyals		Overall SmartPLS/pls
	REBUS	FIMIX	REBUS	FIMIX	REBUS	FIMIX	
PEOU-	0.76	0.81	0.59	0.47	0.96	0.99	0.72
PEOU-A	0.75	0.51	0.43	0.42	0.77	0.45	0.49
PU-A	0.10	0.42	0.37	0.31	0.15	0.54	0.39
PU-BU	0.39	0.17	0.14	0.04	0.82	1.21	0.29
A-BU	0.43	0.73	0.65	0.55	0.11	0.92	0.47
A-BIFU	0.18	0.12	0.44	0.13	0.22	-0.68	0.25
BU-BIFU	0.68	0.67	0.24	0.47	0.74	0.47	0.63
Cluster	41%	62%	33%	31%	26%	7%	100%

Table 4. Model parameters across the segments

Segment 1 of Moodle users can be described as “easiness seekers”. This segment is characterized by positive and strong relations between perceived easiness of system use and attitude and perceived usefulness that highly predict the use and intentions toward the future use. In the FIMIX solution this is the dominant segment of UEK Moodle e-Platform. The second segment is characterized by attitudinal relationships with perceived usefulness and corresponds strongly to behavioral intentions of the future use. The segment can be labeled as “emotional” toward the Moodle system because the attitude and positive overall evaluation have the highest impact on behavioral intentions. Segment 3 consists of “loyals” because of the strong relationship between perceived usefulness and intentions of the future use. The attitudinal relations are weak or insignificant in the explanation of the intentions of use of Moodle system.

The model goodness of fit indexes across the extracted segments is provided in Table 5.

Latent dependent	Easiness seekers		Emotionals		Loyals		Overall R ²
	R ²		R ²		R ²		
	REBUS	FIMIX	REBUS	FIMIX	REBUS	FIMIX	
PU	0.54	0.67	0.30	0.16	0.87	0.99	0.51
A	0.66	0.79	0.44	0.38	0.88	0.98	0.67
BU	0.50	0.53	0.50	0.30	0.89	0.84	0.51
BIFU	0.70	0.82	0.46	0.33	0.88	0.96	0.66
GOF	0.62		0.48		0.85		0.63
GQI	-		-		-		0.65

Table 5. Goodness of fit indexes across clusters

The Group Quality Index (GQI) is 0.65 and it is higher than GoF for total sample. It means that local models in heterogeneous population perform slightly better than global model. The determination coefficients R² and GoF indexes show relatively good fit within the clusters 1 and 3. The overall GoF in

cluster 2 is far below acceptable level. However, the R^2 coefficients indicate that sufficient portion of variance of the dependent latent variables is explained by the set of predictors.

Segment Profiles

The segments of Moodle users were profiled using the set of variables concerning the basic socio-demographic characteristic, the position in academic system and net promoters score index. The Figure 5 presents the plot of classification tree that represents the profiles of the segments. The direct stop FACT was used in tress pruning. Gini measure was used for fitting the model.

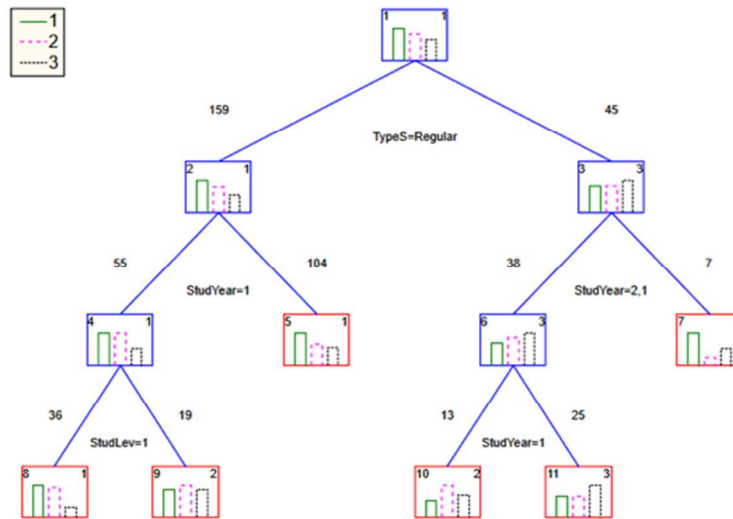


Figure 5. Segment profiles using CART

The “Easiness seekers” are primary the regular, 2nd year undergraduate students. The median of NPS score for this segment is 6 and the difference between fractions is $0,14 - 0,52 = -0,38$ what indicates that the members of this segment are detractors and are strongly dissatisfied with the Moodle platform. The “Emotional” segment consists with regular undergraduate “freshmen” students of 1st year and part-time students of the 1st year. The median of NPS score for this segment is 7 and the difference between fractions is $0,12 - 0,32 = -0,20$ what indicates that the members of this segment are passives and are dissatisfied with the Moodle platform. The “loyal” segment is mainly consisted of part-time more mature students of 2nd year. The median of NPS score for this segment is 8 and the difference between fractions is $0,38 - 0,31 = +0,7$ what indicates that the members of this segment are promoters and are quite satisfied with the Moodle platform. The gender of students does not differentiate the segments.

Conclusion

Usually the estimation of TAM-based models assumes the homogeneity of population under study. The student population as a target of education process cannot be seen in such way. The assumption of heterogeneity of the students’ population gives the opportunity to use the proposed model to segment Moodle users using FIMIX and REBUS PLS-PM. The predictive and model-based segmentation opens the new usability of TAM model in the context of usage and attitudes (U&A) toward the Moodle platform. The presented research gives also additional arguments on correctness of using TAM to analyze user attitudes and their behavior in the context on e-learning in general and Moodle in particular. It introduces a new construct to the original TAM aiming at forecasting the user’s *ex post* behavior. Introducing additional covariates enabled getting an insight into the segments of respondents and structures them into three behavior patterns. Discovering the user segments within e-learning audience has practical implications related to teaching/learning process. It indicates that particular segments of students are sensitive to specific evaluation of relationships between different components of path model. It may be helpful to

understand the key success factors that are behind the use of Moodle platform for specific students. It indicates that e-learning system at CUE needs to be perceived from two different perspectives, i.e. full-time and part time students. The first group, which naturally in a greater degree is supported through face-to-face class experience, is not as positive toward the e-Platform as the second group for whom distance learning is a more compulsory factor. This also raises the questions concerning the factors stimulating positive and negative recommendations for CUE e-Platform, which may be addressed in the continuation to this research.

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