DEALING WITH MALFUNCTION: LOCUS OF CONTROL IN WEB-CONFERENCING

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ABSTRACT

This paper considers how students deal with malfunctions that occur during the use of web conferencing systems in learning arrangements. In a survey among participants in online courses that make use of a web-conferencing system (N = 129), the relationship between a preference for internal or external locus of control and the perception of technical difficulties is examined. This study starts from the idea that the experience of malfunctions has an influence on the acceptance of information systems in education, while support services are availed mainly by users who act responsible in using technology anyway.

KEYWORDS

Malfunction, Technology Acceptance, Web-Conferencing, Webinar, Locus of Control

1. INTRODUCTION

People who are involved in teaching and learning often consider the use of an information system in terms of substitution. That is: A digital appliance replaces analogue practice. Especially online communication and collaboration – online courses in the realm of education – are compared with face-to-face meetings. Starting from the notion of “cyberspace” for the Internet, we are used to metaphors that compare applications of information and communication technology to known and familiar structures of the real environment (“space”) that surrounds us. In this paper we consider “virtual classrooms”, referring to the use of web-conferencing systems for synchronous online collaboration in education.

In this introduction we are going to review the relevance of malfunctions that occur during the use of web conference systems for the acceptance of information systems in education. We then draw attention to the concept of locus of control, which might explain the prevalence of technical difficulties. In the second part of this paper, we present a study that examines the preference for internal or external locus of control concerning technical difficulties in online courses. A conclusion ends this paper, which presents some insights for support services in online education and questions for further research.

1.1 Technology Acceptance and Malfunctions

It stands to reason that a comparison between two forms of collaboration is followed by a preference for one or the other option. In a comparison between two ways of interaction and conversation, people are likely to consider the additional benefits of each alternative. They may also deliberate on efforts that can be avoided or even may imagine opportunities that arise from a combination of both alternatives. The individual weighting of single factors, the evaluation of specific criteria and even expectations concerning the options at stake are rarely purely rational. Nevertheless, the acceptance of a new, technology-based form of communication and collaboration can be explained by a cost-benefit analysis. Some values justify the use of technology for teaching and learning, for example, the avoidance of expenses for travel, or an increased benefit such as better learning opportunities – or, maybe, just the fun to make use of a new technology.

Furthermore, it may be assumed that the need to ensure the correct operation of the technical equipment adds as an expense in this cost-benefit analysis. The provision for a flawless operation requires time, and material as well as personnel resources. Personnel resources include knowledge, experience and problem-solving strategies. Malfunctions, breakdowns or system failures interrupt or diminish the benefits of technology use. In addition, malfunctions cost time for troubleshooting and fault elimination. Malfunctions in web conferencing are particularly burdensome. As opposed the use of Internet technologies in asynchronous mode (for example, in online courses with common learning management systems, but also for online education with services and applications of Web 2.0), synchronous online collaboration (employing video and audio conferencing as well as a shared workspace or a shared desktop) is likely to stop when one participant encounters a technical problem. Technical malfunctions in web-conferencing often result in poor audio quality, e.g. noise or echo in voice transmission, unbalanced sound volume, or even in acoustic feedback (Larsen effect). Frequently, video pictures from some participants are missing, due to a wrong set up of their webcams or low bandwidth. Low bandwidth or server overload may also result in high latency, which confounds the notion of real-time collaboration in a joined workspace.

In addition, web-conferencing systems are quite complex. The average user is unable to evaluate the reason for malfunctions. In web-conferencing, insufficient sound quality may be due to server load, bandwidth of the Internet connection of single participants, the encryption in the domestic Wifi network, or even hardware of one participant, like cable, microphone and speakers. It is noteworthy that most of the web conferencing systems from the current generation provide a functionality to integrate a conference call on landline telephones in the meeting, in order to ensure hassle-free conversation. The landline telephone network is considered to be both easy to use and extremely reliable.

And although landline telephony nowadays is based on a global technical system that is, like the Internet, digital and packet-oriented (cf. Janevski, 2014, S. 23ff), we take landline telephones “for granted”, that is: They are considered to be part of the “real world”, and not part of “cyberspace”, just like most of artefacts that surround us in everyday life as well as in learning spaces. As long as walls, tables, pens or projectors fulfil their function without difficulty, they disappear from consciousness. Only a malfunction, or a “breakdown” (with reference to Heidegger cf. Winograd & Flores, 1986, S. 68ff), discloses technology.

Neither research in instructional design nor development in technology enhanced learning has addressed malfunctions in technical systems, their impact on teaching and learning or their relevance for the acceptance of digital technology in education broadly. More generally, there is only few research on anger and frustration in dealing with software and computers (cf. Bessière, Newhagen, Robinson, & Shneiderman, 2006; Charlton, 2009). Ergonomic requirements for the use of software applications name “error tolerance” and “conformity with user expectations” as two out of ten design principles (ISO 9241-110, see Schneider, 2008). Usability evaluation is oriented at these principles, as well as their relevance to perceived usability is investigated (cf. Pataki, 2009, S. 100ff). However, current models on technology acceptance (TAM3 as a prominent example, cf. Venkatesh & Bala, 2008) do not explicitly incorporate negative, hence frustrating user experiences as explanatory factors. Malfunctions are likely to affect both “perceived usefulness” and “perceived ease of use”; but still, in TAM3 these factors are explained by external determinants (like subjective norm) and internal determinants (like computer-related self-efficiency), not by frustrating events.

Obviously, research and development in technology enhanced learning is based on an affirmative attitude: Since everybody wants to demonstrate how things work, reports on failure are hard to publish. Therefore, from a technical perspective malfunctions are generally regarded as a technical problem, which in turn is to be solved with more or better technology (cf. Morozov, 2013). Education however, should take into account how students adopt technology. The efforts to care for the hassle-free operation are only one part of the story. Becoming aware of personal responsibility in dealing with technology is a prerequisite for the responsible use of technology, and as such, an important part of media literacy.

1.2 Locus of Control and Malfunction

There is an important differentiation for efforts in dealing with malfunctions: time, knowledge and problem-solving strategies for coping with malfunctions are individual resources; while technology itself, infrastructure as well as staff for maintenance and support are usually beyond control and influence of the individual user. The concept of locus of control suggests itself here (cf. Rotter, 1954, S. 105ff). In differential psychology, we may differentiate between an internal locus of control and an external locus of control, that is: People are more or less convinced that events are the consequence of individual action (not necessarily of their own), or that events can not be influenced by individual action. In various fields of research, this distinction was further elaborated towards a multidimensional model. Interestingly, relevant research is rather concerned with failure than with success. The notion of locus of control comes into play when the avoidance of damage or the improvement of pain is addressed. There is considerable research in the field of health, illness and recovery, including the Multidimensional Health Locus of Control Scale (MHLC) regarding individual attitudes and beliefs towards illness and healing (cf. Wallston, Wallston, Kaplan, & Maides, 1976).

For a technology-related field, some studies on risky driving behaviour are apposite to the question of this paper. For issues related to road accidents, there is a scale measuring dimensions in locus of control concerning traffic (cf. Özkan & Lajunen, 2005). The starting point here is the assumption that an internal locus of control in terms of traffic accidents is a key prerequisite for drivers to avoid risky driving. The named study differentiates the external locus of control between technology (e.g., the condition of the vehicle, the condition of the road) and fate; as well as the internal locus of control beliefs are distinguished between self and other road users. This structure allows an analogy to the study presented in this paper. The use of web conferencing systems is a complex technical system that requires a well operating infrastructure (servers, broadband Internet), while disturbances are hard to assess and therefore may appear to be fateful. In addition, multiple users contribute to the success of communication and collaboration; hence users might attribute responsibility for error-free operation to themselves or to their peers.

1.3 Research Questions and Hypotheses

The field of the present study is web-based synchronous collaboration. We examine web-conferencing in the context of online education, using Adobe Connect™ for course sessions, also known as “virtual classroom” or “webinars”. The objects of the investigation are the dimensions of locus of control, and their relation to technical malfunctions. In view of the above, the following questions arise:

- Is it possible to assess different dimensions of locus of control with respect to malfunctions in collaborative, web-based work environments?
- Is there a connection between the locus of control and perception of technical difficulties?

Accordingly, the working hypotheses are that locus of control beliefs for coping with technical difficulties have a dimensional structure, and that, in view of differential psychology, there is a relationship between the dimensions of locus of control and the perception of technical difficulties.

An educational relevance of this relationship arises from the very pragmatic question of suitable support services as well as from issues related to the acceptance of web-based synchronous collaboration in online education. As already mentioned, the questions that have been raised are also relevant with respect to media literacy, since internal location of control beliefs are a prerequisite for responsible handling of technology.

2. INVESTIGATION

As part of a survey on the acceptance of web-conferencing systems in distance education (cf. Junge, Klebl, & Mengel, 2011) students of the University of Hagen (N = 129) have been asked about the *Level of Perceived Technical Difficulties* while attending synchronous online sessions (i.e. “webinars” with audio and video communication as well as with shared presentation or shared workspace). In the following, we present the research design and the research instruments, and then outline the sample. In a third subsection, the results of the statistical analysis are presented. The paper concludes with a summary of results and an outlook to follow-up research in the last section.

2.1 Research Design and Instruments

The survey was conducted via an online questionnaire (in German language). Only students that had already participated in one or more web-conferencing sessions using Adobe Connect™ were invited. As part of a planned analysis to the Extended Technology Acceptance Model (TAM3, cf. Venkatesh & Bala, 2008), the questionnaire comprised scales for *Computer-Related Self-Efficacy*, *Computer Anxiety*, and *Computer Playfulness*. Based on existing survey instruments, new items had been developed for the presumed dimensions of *Locus of Control* (*Self*, *Other*, *Technology*, *Fate*, *Authority*), which are essential for the study presented here.

Likert scales were used for all the latent variables mentioned so far, with three or four items per each factor based on a reflective measurement model. In order to provide the opportunity to express an indecisive attitude, five response options were offered (from "totally agree" to "totally disagree"). The coding was carried out by numbers 1 to 5, where a low value represents a high level of agreement with the item statement. The online questionnaire represented the response options horizontally, with equal distance between the radio buttons. As generally accepted for Likert scales, we consider the response options as an equidistant scale and treat the resulting manifest variables as interval-scaled.

In addition to these factors, the *Level of Experience* with the web-conferencing system Adobe Connect™ is of importance for the further report of the study. Therefore, we asked for the number of sessions where the respondents had participated. In the following subsections, we give more details about the latent factors.

2.1.1 Level of Perceived Technical Difficulties

Some item statements concerning the *Level of Perceived Technical Difficulties* addressed the time factor (e.g. "Due to technical problems, sessions with Adobe Connect are unnecessarily prolonged.") In addition, items considered cognitive load in relation to technical difficulties (e.g. "Occasionally, the distraction caused by technical errors outweigh the benefits of Adobe Connect."). The four items used result in a consistent scale (Cronbach's $\alpha = .88$). On average, the level of technical difficulties is perceived as neutral ($\bar{x} = 2.8$) and has a reasonable variance ($SD = 0.9$).

2.1.2 Locus of Control: Self, Other, Technology, Fate, Authority

Item statements for *Self*, *Fate* and *Authority* as dimensions of *Locus of Control* were adapted from the German version of the Multidimensional Health Locus of Control Scales (MHLC), according to Muthny & Tausch (cf. 1994). However, four items were selected from six. They describe aspects such as responsibility (e.g. for *Self*, "I am responsible for ensuring that the session using Adobe Connect works well.") or compliance (e.g. for *Authority*, "The best way to work smoothly with Adobe Connect is to follow the instructions exactly."). In order to measure locus of control beliefs in terms of *Other*, various aspects such as responsibility, carefulness or behaviour were transferred from item statements related to *Self* (e.g. "Only if all participants have the required technical skills, a meeting with Adobe Connect can operate smoothly.").

Statements about *Technology* were only loosely inspired by the English questionnaire for Traffic Locus of Control (T-LOC, cf. Özkan & Lajunen, 2005). The transfer considered abstract concepts of complex technical systems (such as infrastructure, in T-LOC "dangerous roads", for web-conferencing "Often, there is something wrong with Adobe Connect since the Internet connection is interrupted."). The locus of control beliefs are assessed object-related, that is: Each item statement comprises or implies a reference to the employed web-conferencing system Adobe Connect™.

A confirmatory factor analysis was executed in order to validate the presumed dimensional structure (extraction of factors by Principal Component Analysis, Varimax rotation with Kaiser Normalization). However, not all dimensions emerged in the factor structure clearly while involving all twenty items. In particular, the items related to the influence of the *Authority* do not form a consistent dimension and mingle with the items for *Self*. A second, exploratory factor analysis that excludes seven items without clear relation to a latent factor is apt to validate the dimensions *Self*, *Other*, *Technology*, and *Fate* with the remaining thirteen items. Conceptual considerations and a final audit of internal reliability result in a dimensional structure with four items for these four dimensions of locus of control (with $.55 < \text{Cronbach's } \alpha < .85$). The dimension of the *Authority* was not longer considered in the following evaluation. The locus of control beliefs for *Self*, *Other*, and *Technology* are rated on average slightly more affirmative ($2.7 < \bar{x} < 2.9$), for *Fate* slightly more negative ($\bar{x} = 3.5$). The factor *Technology* has a lesser variance ($SD = 0.6$) than the other dimensions ($0.7 < SD < 0.8$).

2.1.3 Computer-Related Self-Efficacy, Computer Anxiety, Computer Playfulness (Anchor Factors)

The item statements of these latent factors match an adequate translation of the *anchor factors* from the Extended Technology Acceptance Model (TAM3, cf. Venkatesh & Bala, 2008). There, they form a general framework for the acceptance of specific software applications, supplemented by Perceived External Control.

In contrast to the latent variables for the locus of control scales these anchor factors are operationalised without reference to any specific information system. For all three latent factors, the respective four manifest variables generate a consistent scale (with $.71 < \text{Cronbach's } \alpha < .86$). The respondents rated *Computer Anxiety* on average rather low ($\bar{x} = 4.4$), while in contrast they assessed their *Computer-Related Self-Efficacy* and their *Computer Playfulness* rather high ($\bar{x} = 1.9$ and $\bar{x} = 2.2$).

2.1.4 Level of Experience

Three groups for *Level of Experience* were formed based on the requested number of meetings in which the respondents participated. A separation between *once*, *several times* (2 to 3) and *frequently* (4 or more) resulted in approximately equal groups (N = 45 , 41, 43).

2.2 Sampling Design and Data Collection

Data were collected via an online questionnaire. For pragmatic reasons, students that participated in online courses using the web-conferencing system Adobe Connect™ were asked to participate in the study. To this end, lecturers were asked to send an e-mail with an invitation to the students who have participated in their course between or shortly after the lessons. Therefore, it is not known how much students actually were asked to participate; hence it is impossible to give a statement about the return rate. In addition, conclusions about effects of cluster sampling are not possible, because it can be assumed that individual students had participated in several courses and, therefore, were invited twice or more to participate in the study. Participation was rewarded by inclusion in a prize draw. Participation in the draw was voluntary and anonymous by means of an identification number.

2.3 Results

A total of 133 students participated in the survey and fully completed the questionnaire. Due to implausible data (in particular on the number of meetings in which the respondents have participated) four records were excluded. Of the remaining 129 respondents, three-quarters were female (76%), one quarter male (24%). On average, participants were 36.8 years old. The standard deviation in age was 8.1 years, with an age range from 21 to 59 years. Most students are enrolled at the Faculty of Cultural Studies and Social Sciences (76%). The remaining participants study at the Faculty of Mathematics and Computer Science and at the Faculty of Law.

2.3.1 Relationship between Locus of Control and the Level of Perceived Technical Difficulties

Starting from the working hypothesis, that there are different dimensions of locus of control in coping with malfunctions, and that these different locus of control beliefs influence the perception of technical difficulties, the relationship between the dimensions of locus of control beliefs and the level of perceived technical difficulties has been investigated. Of course it is impossible to draw a conclusion of cause and effect from a statistical correlation at the first attempt.

A Pearson's product-moment correlation for each dimension in *Locus of Control* (*Self*, *Other*, *Technology*, *Fate*) results in moderately strong correlation coefficients that are each highly significant ($p < .01$). There are the negative correlations for the internal dimensions (*Self* $r = -.38$; *Other* $r = -.29$). Students who experience fewer technical difficulties are more likely to believe that they or others can influence successful operation. As expected for the external dimensions, the correlations are positive (for *Technology* $r = .41$, for *Fate* $r = .55$). People who tend to assume that errors in technology or just fortune determine successful operation experience more technical difficulties.

In addition, the interactions have been tested by a regression analysis, using the *Level of Perceived Technical Difficulties* as the dependent variable. A linear regression analysis which includes all four dimensions as independent variable in the model results in an explained variance of 33%. In this case, only the regression coefficient for the external locus of control beliefs are significant ($p < .05$) and confirm the positive relationship (for *Technology* ß = .34; for *Fate* ß = .47).

2.3.2 Relationship between Anchor Factors and the Level of Perceived Technical Difficulties

It raises the question whether more general psychological dispositions in relation to the use of computers determine the perception of technical difficulties, in contrast to the specific beliefs of locus of control related to the particular web-conferencing tool in this study. With the anchor factors of TAM3 (*Computer-Related Self-Efficacy*, *Computer Anxiety*, and *Computer Playfulness*), the questionnaire assessed attitudes towards computer in general, which may also determine the perception of technical difficulties.

A Pearson's product-moment correlation for each *Anchor Factor* in relation to the *Level of Perceived Technical Difficulties* demonstrates no significant correlations. Also, the result of a linear regression analysis with the *Level of Perceived Technical Difficulties* as the dependent variable yields no relation. Only about 5% of the variance in perceived technical difficulties is explained by the anchor factors. For the present study, no influence of general attitudes toward computer usage on the perception of technical difficulties can be found.

2.3.3 Relationship between Locus of Control and Anchor Factors

Furthermore, the dimensions in *Locus of Control* are independent from the general attitudes toward computer usage as well. The matrix of Pearson's product-moment correlation between the dimensions in *Locus of Control* (*Self*, *Other*, *Technology*, *Fate*) and the *Anchor Factors* of TAM3 (*Computer-Related Self-Efficacy*, *Computer Anxiety*, and *Computer Playfulness*) reveals no significant correlations, with only one exception. There is a low, but significant correlation between *Computer Playfulness* and the *Locus of Control for Other* ($r = .22$ at $p < .05$). Some of those who like to experiment with the computer are slightly inclined to shift blame for any malfunction in computer-based interaction to others. Nevertheless, from the present study it can be assumed that the dimensions of locus of control are independent constructs.

2.3.4 Level of Experience as a Possible Cause

One question that remains unanswered so far is whether different control beliefs actually affect the perception of technical malfunctions, or, on the contrary, a repeated experience of technical malfunctions causes people to develop an attitude of powerlessness. Who often experienced that technology does not work will be inclined to value own capabilities inferior to technical operations and fate. Reversed: Who is convinced that the responsibility for error-free operation lies with the users, will take action to prevent malfunctions.

The present study may provide a clue how to explain the relationship between *Locus of Control* and *Level of Perceived Technical Difficulties*. It is assumed that it makes a substantial difference, whether a user uses a tool for web-conferencing *once* (for a typical session of a maximum of 120 minutes), *several times* (several sessions over at least a week or two) or *frequently*. The more often the tool is used, the more likely are malfunctions. At the same time users get used to the system and gain some skills and knowledge in troubleshooting, especially when users tend to internal locus of control beliefs (*Self*, *Other*).

A review of the differences between the groups that had taken part in sessions with the web-conferencing tool *once*, *several times* or *frequently* does not result in significant mean differences, neither for the *Level of Perceived Technical Difficulties*, nor for the dimensions in *Locus of Control* (One-way ANOVA, equal variances assumed, post-hoc test with Tukey-HSD).

It may therefore be concluded for the present study that both the dimensions in *Locus of Control* in coping with malfunctions as well as the *Level of Perceived Technical Difficulties* remain stable over a certain period of time. In this short term view, experience does not affect locus of control beliefs. Under the assumption that frequent use cause more technical errors, it may be concluded that it is not the perceived technical difficulties which affect the locus of control beliefs, but vice versa.

2.3.5 Gender Differences

Despite the unbalanced distribution of men and women in the sample, an analysis on differences between the sexes is advised. In general, there are no significant mean differences for the dimensions in *Locus of Control*. However, women tend to perceive more technical difficulties (*Level of Perceived Technical Difficulties*: $\bar{x} = 3.3$ for women compared with men $\bar{x} = 2.7$, t- test $p < .05$). Therefore, differences between men and women contribute to the variance in the perception of technical difficulties. It is not clear what disposition may provide an explanation here, since there are no significant mean differences between the sexes for the *Anchor Factors* of TAM3 (*Computer-Related Self-Efficacy*, *Computer Anxiety*, and *Computer Playfulness*).

3. DISCUSSION

The study presented in this paper confirms the assumption that it is possible to differentiate dimensions of locus of control beliefs for coping with malfunctions in web-based collaborative work environments. These locus of control beliefs are, on the one hand, *internal*, relating to human beings as responsible and capable: The participants in the study consider it more or less important, what they or others do to avoid malfunctions. On the other hand, locus of control beliefs are *external*, that is: The respondents consider it more or less a matter of technology or fate whether something works or not.

It can also be shown that these locus of control beliefs are associated with the perception of technical malfunctions. Who has an internal locus of control faces less technical difficulties. Who is convinced that the influence of human beings is limited perceives more technical difficulties. By comparing with the level of experience in using the web-conferencing tool in question it can be concluded that negative experiences of technical difficulties do not affect the locus of control beliefs. Hence, locus of control beliefs guide the perception of malfunctions. These locus of control beliefs are more general than self-efficacy expectations. That is: There is no salient difference between the attribution of responsibility to oneself or to others; just as there is no important difference between the consideration of technology and destiny. The decisive difference lies in the attribution of responsibility to human actors as opposed to non-human factors.

Starting point for the present paper is the assumption that malfunctions of technology in teaching and learning add to the individual cost-benefit analysis concerning the usage of information systems in education. On the basis of the above, it can be concluded that the perception of technical difficulties is significantly determined by different dimensions of locus of control. However, the study presented above has not investigated the direct relationship between malfunction and acceptance. This connection is quite plausible, but not proven as yet.

Given the model of technology acceptance TAM3 (cf. Venkatesh & Bala, 2008), it stands to reason that experiences of malfunctions have influence on “perceived ease of use“ as well as on “perceived usefulness”, and thus have impact on “behavioural intention to use”. Here, further investigations should assess the relevance of failure and frustration. It would be interesting to examine the time course of frustration and competence in the context of locus of control beliefs. We suggest a U-shaped curve of competence experience in coping with malfunctions: Initial difficulties may lead after a few sessions to an experience of powerlessness. After a while, users acquire routines to manage these difficulties or to avoid them. This leads to a competent and self-responsible use.

The present study is approached from the perspective of differential psychology, which underlies the concept of the dimensional structure of locus of control beliefs. Different people have different preferences, to which they attribute responsibility for an error-free operation. These preferences – internal or external attribution; to *Self*, *Others*, *Technology*, or *Fate* – is of importance for preparing and supporting the use of technological devices and applications in communication and collaboration. It can be assumed that support services will be accepted from those persons who have an internal locus of control, in particular for the dimension of *Self*. Who believes that the responsibility for a trouble-free session lies with herself or himself, will read the instructions needed to prepare everything well and is likely to develop routines for trouble-shooting, in order to experience less technical difficulties.

However, those who are inclined to believe that nothing can be done anyway, because technology simply is supposed to work (and if not, this is due to defects or misfortune), will not be accessible for instructions and help during preparation. The result could be described as “preaching to the converted” – more often than not observed by support stuff: Any services reach only those who are already in a position to act responsibly with technology.

The question remains about how to help and support those who currently take little or no responsibility for the prevention of malfunction. From the concept of locus of control, it can be concluded that services that fully exonerate the user are indeed well received by people with external locus of control beliefs, but then require more and more support, since they do not encourage self-reliance. Therefore, support service should promote personal responsibility for technology use. This can be done, for example, by setting goals for an online course, targeting an undisturbed web-conferencing session by evaluating malfunctions and praising circumspection, know-how and responsibility. The factors that foster self-reliance in adequate settings could be the subject of further research and development.

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