Who prefers online teaching and learning? The relevance of students' personal characteristics and learning strategies

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Structured Abstract

Background: Students' learning is influenced by students' personal characteristics and learning strategies. There are learning-oriented and grade-oriented students. To predict study outcome, the "big five personality characteristics" (Van Bragt et al., 2011) can be used. Those are extraversion, agreeableness, conscientiousness, emotional stability and autonomy as well as personal orientations on learning and students' study approach. Other personality characteristics are for example motivation or students' self-concept. Three learning strategies have been mentioned in the literature: cognitive, metacognitive and resource management learning strategies. Learning strategies can be defined as the learning behaviour and the attitudes behind this behaviour.

Purpose: For online teaching in courses on STEM subjects, an online questionnaire was developed, used and evaluated. The study focusses on relationships associated with students' preference for online teaching and a preference for classroom learning. The relationships between the students' personal characteristics and attitudes and their general learning strategies towards online learning have been evaluated.

Sample/Setting: The evaluation was conducted at a German university in the course "Organic chemistry for non-major chemistry students". 71 students participated in the evaluation of the course in weeks 4-5. The students were informed on the use of their data for this study; ethical guidelines were followed. The students received a link for the online questionnaire and participated anonymously.

Design Methods: Quantitative (online questionnaire) methods were used. The questionnaire consists of two parts: questions on longtime learning behavior and questions on online learning. For the items an explorative factor analysis was calculated for students' personal characteristics, general learning strategies and the assessment of the online learning. This resulted in 17 subscales. In addition, Spearman correlations between personal characteristics and selected learning strategies and assessment of online learning have been calculated. A hierarchical regression analysis has been used for predicting a preference for online learning versus classroom learning.

Results: Students' enthusiasm and study satisfaction show a large correlation with their appreciation of online provided as learning resources during the online term. However, these personal characteristics of students show only small correlations with the preference for online learning and classroom learning. Positive correlations for online learning show negative for classroom learning. The relevant learning strategies ("effort", "general time management", "literature use", "learning environment" and "control") correlate mostly signficantly but always negatively in a small range with a preference for classroom learning. Poorly developed general learning strategies could let students prefer the less self-regulated learning. However, for predicting a preference for online learning, general learning strategies seem to have a limited value. The successful mastering of the requirements during the online term seems to be more relevant, independent from the expression of general learning strategies.

Conclusions/implications for classroom practice and future research: The questionnaire can be used for evaluating online courses if the interest of the researcher or practitioner includes correlations between learning strategies and personal characteristics with the teaching method. By using the questionnaire, interesting insights into those correlations can be gained. Before teaching online courses, self-regulated learning (SRL) of students should be promoted as it is known that students can acquire and strengthen self-regulatory processes. It could help students acclimatize to the course requirements, general resources, and software resources. For future research it would be interesting to use the questionnaire in an online course after the promotion of students' SRL.

Keywords: *organic chemistry, online-course, evaluation, personal characteristics of students, learning strategies*

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1 Introduction

The COVID-19 pandemic as a global event challenges society worldwide (Holme, 2020a). Teaching and learning at the beginning of the pandemic included emergency remote teaching that was anything other than chaotic (Holme, 2020b). The Journal of Chemical Education therefore published a special issue ("Insights gained while teaching chemistry in the time of COVID 19") with many articles on how teachers worldwide reacted to the demands during the pandemic. However, due to the velocity with which this issue was made, the "potential for carefully designed experimental measures of the impacts on learning was limited" (Holme, 2020b). Therefore, there is a need to evaluate (recent) online courses and to monitor students' learning. It can be assumed that the change from in-class to online courses influences the learning strategy of students or vice versa, because it is known that students' learning strategies influence their academic success (Erdem, Keklik and Keklik, 2013; Gokalp, 2013; Zimmerman, 2001). In this paper we used a newly developed online questionnaire for the evaluation of a course on organic chemistry. This evaluation focussed both on the relationship between students' personal characteristics and attitudes towards online learning and the relationship between students' general learning strategies and attitudes towards online learning.

2 Theoretical Background

Although many teachers seemed to be overrun by the switch from in-class teaching to online teaching, online teaching is not a new phenomenon. In 2014, 33.5 % of higher education students in the United States took at least one online course (Allen and Seaman, 2014). The technical prerequisites are mostly available; the pedagogy, or "art of teaching" online is often lacking; "online teaching traditionally has been directed toward the self-directed, nontraditional, adult learner" (Cuellar, 2002). The following aspects are associated with online learning: accessibility, affordability, flexibility, learning pedagogy, life-long learning, and policy (Dhawan, 2020). Online learning is therefore often described as "the possibility to learn from anywhere, anytime, and in any rhythm, with any means" (Cojacoariu, Layzar, Nedeff and Lazar, 2014). But "online learning has so much of time and flexibility that students never find time to do it" (Dhawan, 2020). As major barriers for online learning, students named the lack of community, technical problems, and difficulties in understanding the instructional goals (Song et al, 2004). During the COVID pandemic, all students have to attend online courses; they cannot choose between in-class and online courses. The learning environments and experiences of students suddenly forced into emergency remote online learning were explored by Jeffery and Bauer (2020). Students reported more difficulty maintaining focus during the live online sessions than during in-person lectures. As a solution, information should be prepared in smaller chunks. For co-learning and crosstalk, breakout rooms should be used. However, the students appreciated the ability to review recorded lectures. Because full lectures often take a long time, the use of podcasts for reviewing important content was described for example by Hermanns, Schmidt, Glowinski and Keller (2020). A combination of course teaching through Zoom videoconferencing and the additional use of the Moodle platform for sharing course information, materials and facilitating the discussion board was described by Ramachandran and Rodriguez (2020).

Militiadous, Callahan and Schultz (2020) evaluated the students' success in an online-course in comparison with a former in-class course. They found that "many students prefer to attend face-to-face when this is available. When it is not possible, a live and interactive environment is valued over non-interactive offerings as recordings". Ali and Leeds (2009) reported significant higher dropout rates in online courses than in face-to-face courses. This can be explained by the students' lack of self-regulated learning (Cho and Shen, 2013), but also by personal reasons (Nichols, 2010).

For distance learning, as for example in online courses, self-regulated learning and cognitive transfer of skills and knowledge are even more important than in in-class courses (Barak, Hussein-Farraj and Dori, 2016). Self-regulating becomes a critical factor for success in online learning. When students can choose between online and in-class courses two factors significantly contribute to their decision: control over the pace and timing of learning (more important for students who prefer online) and personal interaction with instructors and students (more important for students who prefer in-class) (Barnard, Yan, To, Paton and Lai, 2008).

The need to evaluate online courses arises although online courses share common characteristics with face-to-face courses (Beningno and Trentin, 2000). Beningo and Trentin state that the evaluation of online courses has to include both the learning process and the participants' performance. They propose a framework for the evaluation of online courses that includes participants' individual characteristics, the quality of the learning material and the effectiveness of the support offered by tutors and experts. Students' perspectives on online learning amid the Covid-19 pandemic has been evaluated by Adnan and Anwar (2020). In their study they examined the general attitudes of higher education students regarding online teaching. The students reported that learning in face-to-face courses is more motivating than in online courses. They also miss on-campus socialisation. For a flipped classroom course on organic chemistry, Mooring, Mitchell and Burrows (2016) evaluated student attitude and achievement. Students' achievement in the flipped course were higher in the midterm exams, not at the final exam. A possible explanation could be that the students can learn more at their own pace. The students were also emotionally more satisfied than in a traditional course. Because a flipped course includes online and face-to-face teaching and learning, the question remains how students rate online

courses without face-to-face elements. If students attend such a course, it can be assumed that students' personal characteristics and their learning styles are relevant for their rating of an online course.

Students' learning is influenced by students' attitudes towards learning (Lovelace and Brickman, 2013). Students differ in their attitudes towards learning and grading (Eison, 1981). Evaluation of students' personal characteristics of learning shows for example that there are learning-oriented students and grade-oriented students. The first group of students showed better study habits, had less test anxiety and used higher collaborative and participative learning styles (Eison, 1982). Because student attitudes have an impact on their learning, measuring those attitudes can be a part of research studies of instructional inventions (Lovelace and Brinkman, 2013).

Differences in personal characteristics cause individuals to react to learning situations in their own ways (Carver and Scheier, 1992). Van Bragt, Bakx, Bergen and Croon (2011) used the "Big Five personality characteristics" for their study on students' personal characteristics predicting study outcome: extraversion, agreeableness, conscientiousness, emotional stability and autonomy as well as personal orientations on learning and students' study approach. In their study they found that "conscientiousness" and "ambivalence and lack of regulation" are significant predictors for credits and study continuance. An overview on students' personality for physical education has been given by Kirch, Schnitzius, Mess and Sprengler (2019). They showed that many studies focused on the relationships between students' characteristics and their achievement. Relationships between individual personality facets (e.g. interest) and learning outcomes (e.g. performance) became visible. Further personality facets named are self-concept or motives.

Besides students' personal characteristics, their learning strategies should also have an impact on their learning. Therefore, Griese, Lehmann and Roesken-Winter (2015) assessed STEM students' learning strategies. They define learning strategies as "all kinds of planned and conscious learning behavior and the attitudes behind it". Boerner, Seeber, Keller and Beinborn (2005) used the LIST questionnaire for assessing students' learning strategies and validated a shorter version of the questionnaire because the time needed for completing the questionnaire could thus be reduced. The original LIST69 was successfully reduced to LIST36. Such a reduction (to 36 items) is also described by Klingsieck (2019). Significant correlations between students' interest in the content of tasks and their use of learning strategies have been published by Renninger (1992), Pintrich and Schrauben (1992) and Stark (2019).

In the literature, three learning strategy categories have been defined: cognitive, metacognitive and resource management learning strategies (Wild and Schiefele, 1994). Resource management strategies can be used to support the learning process in the best way. The resources include personal (for example support from other students), non-personal (for example information from the library or the internet) and internal resources as for example time and effort. Management refers to the purposeful regulated use of the respective resources and therefore includes metacognitive aspects (Dresel et al., 2015; Wild and Schiefele, 1994).

In our study, we used the combination of items on the personal characteristics and learning strategies of the students with items on their assessment of the online learning to evaluate the online course on organic chemistry.

3 Methods

3.1 Aims of the study

It can be expected that, after the Corona pandemic, university teaching will not fully return to face-to-face teaching. Therefore, this study aims to elucidate factors corresponding with students' preference for online learning and a preference for classroom learning. The following research questions were derived from the previous theoretical background of the study. Based on studies of Renninger (1992), Pintrich and Schrauben (1992) and Stark (2019), which found significant correlations between students' interest in the content of tasks and their use of learning strategies, we wanted to explore the relationship between students' personal characteristics and their use of the most relevant learning strategies and their attitudes towards online learning (research question 1) in addition with the students' attitudes concerning online learning. What is the relationship between the students´ personal characteristics (enthusiasm and study satisfaction) and their use of the most relevant learning strategies and their attitudes towards online learning?

Based on studies investigating the role of learning strategies for online learning (Stark, 2019; Broadbent and Poon, 2015) we formulated research question 2: What is the relationship between students' general learning strategies and attitudes towards online learning? Beyond correlations, we investigated students' personal characteristics and their learning strategies as predictors concerning students' preference for online learning vs. classroom learning to answer research question 3: What factors predict students' preference for online learning versus classroom learning?

3.2 The design of the online questionnaire

For the evaluation of the course "Organic chemistry for non-major chemistry students" a questionnaire was developed. The questionnaire consists of two parts: questions on longtime learning behavior (30 questions) and questions on online learning (30 questions). The items on longtime learning behavior were taken from two instruments: STEPS (STEPS, 2018) and LIST (Boerner, Seeber, Keller and Beinborn, 2005). The items on online learning were developed by Hermanns et al. (2020). For conducting the study, an online tool designed for conducting online feedback (QUAMP) provided by our university was used.

3.3 Sample

The evaluation was conducted at a German university in the course "Organic chemistry for non-major chemistry students". This is a course in the first year for students studying life sciences or nutritional science as their major subjects. The online format consisted of a weekly script with the commented content of the lecture and the seminar, podcasts (especially developed for the online course), tasks for each week with QR-codes for additional information or support, the use of the forum on the Moodle platform for discussions and questions and obligatory online tests.
In the evaluation of the course in weeks 4/5, 71 students participated which are approximately 40 % of the students participating actively in the course (the attendance fluctuates strongly and has been monitored by us using the download numbers for the podcasts used in the course). The students were informed on the use of their data for this study; ethical guidelines were followed. The approval of the institutional review board is not required at German universities. The students received a link for the online questionnaire and participated anonymously. The data were coded.

3.4 Measures and statistical analyses

3.4.1 Students' personal characteristics

For assessing students' personal characteristics, we used well-established and validated scales with regard to students' enthusiasm (respectively interest in the study subject), their satisfaction concerning previous university teaching (study satisfaction) and their confidence concerning their right choice of studies (Lindner et al., 2018) (Tab. 1).

3.4.2 General learning strategies

Students' general learning strategies were examined using a well-established instrument in the area of university learning (LIST, Wild and Schiefele, 1994; Boerner et al., 2005). It is realized as a German-language adaptation of the MSLQ (Pintrich and DeGroot, 1990). Although the LIST has some modifications, the core structure of the MSLQ was adopted. For this study, we had to reduce the number of items. Assuming that cognitive learning strategies are person-intrinsic and more independent from the given learning conditions, we only used items mapping the scale "organisation" from this area. We concentrated on metacognitive and resource management learning strategies that we considered as more relevant in our research context (see theoretical background) (Tab. 1).

3.4.3 Online learning assessment

An explorative factor analysis was calculated for all items concerning the ratings in the assessment of online learning and resulted in four scales derived from factors well fitting in terms of content and with an eigenvalue >1 (Tab. 1). The Kaiser–Meyer–Olkin measure of sampling adequacy was .775, representing a good factor analysis, and Bartlett's test of Sphericity was significant (p < .001), indicating that correlations between items were sufficiently large for performing a factor analysis. The reliability coefficient Cronbach's alpha for the scales is for most scales 0.55 till 0.92 and therefore acceptable to high. Only for the scales "control" and "organisation" Cronbach's alpha is not sufficient with 0.40 and 0.47. However, they were used as well established and validated scales from the LIST. The questionnaire (each item rated with a five-point Likert scale from 1 "strongly disagree" to 5 "strongly agree") consists of the scales presented in Table 1.

Tab. 1. Scale characteristics (N = 71).

Scale Classification	Scale	Items	Reliability coefficient Cronbach's alpha	M (SD)	Example item
Students' personal characteristics					
	Enthusiasm/Interest in subject	3	α= .90	3.40 (.94)	I am enthusiastic about this subject[1]
	Study satisfaction	2	α= .83	3.91 (.90)	I learn a lot in the specialist courses in this subject[1]
	Uncertainty concerning study decision	1	-	1.90 (.99)	I have doubts whether this study is really the right thing for me[1]
General learning strategies					
	Effort	7	α= .71	3.77 (.55)	I do not give up, even if the material is very difficult or complex[2]
	Planning	5	α= .68	3.71 (.65)	Before learning, I think about how I want to learn[2]
	General time management	2	α= .64	3.12 (1.02)	I set certain times when I learn[2]
	Organisation	2	α= .47	3.60 (.91)	I go through my notes while studying and make an outline with the most important points
	Learning environment	2	α= .85	4.21 (.82)	I have the most important documents at hand at my workplace[2]
	Control	2	α= .40	3.71 (.81)	After each section, I pause to review what I've learned[2]
	Regulation	4	α= .55	4.07 (.54)	When I realize that my approach to learning is not working well, I change it[2]
	Peer assistance	1	-	3.82 (1.19)	When something is not clear to me, I ask a fellow student[2]
	Use of literature	1	-	4.07	I look for missing information from various sources (transcripts, books, etc.).[2]
Assessment online learning					
	Appreciation material	5	α= .80	4.03 (.74)	The tasks in the material and their objectives were clearly understandable[3]
	Preference online learning	4	α= .83	3.55 (1.21)	I prefer online teaching over classroom teaching because I can work at my own pace[3]
	Preference classroom learning	4	α= .80	3.30 (1.15)	I prefer classroom teaching because I work more due to the fixed date[3]
	Online Time management	4	α= .74	3.23 (.86)	It was difficult for me to manage the workload I had set myself for online teaching[3] (-)
	Fit study time with private life	1	-	4.06 (1.06)	online semester allows me to coordinate my study time with my private interests

Note. (-) negative formulated item, inverted for statistical analysis.
[1] From the STEP questionnaire (translated from German)
[2] From the LIST questionnaire (translated from German) [3] New items designed by us (translated from German).

Data analysis was conducted in SPSS (Version 25). For all scales Spearman correlations rs with the data of the 71 students that attended the course "Organic chemistry" were determined (Hermanns et al., 2020).

To identify predictor variables concerning a preference of online learning vs. a preference of classroom learning a hierarchical, linear regression model was conducted, which included the predictor variables in four steps. The outcome variables were "preference for online learning" and "preference for classroom learning". In order to detect possible correlations between the independent variables, which could potentially limit the variance explanation of the regression analyses, bivariate correlations between them were first calculated. The strength of these correlations, according to Cohen (1988), can be considered low (r>0.1) medium (r>0.3) or strong (r>0.5), respectively. When adding the predictors to the regression models it was checked in advance for multicollinearity. None of the values for Tolerance and VIF (variance inflation factor) were in a problematic area (Tolerance: values between .4 -.8; VIF: values between 1.1 - 2.3). The result value of the Durbin-Watson test, the Durbin-Watson coefficient, can assume values between 0 and 4. The closer the value of the coefficient is to 2, the lower the degree of autocorrelation. The well-fitting values are reported in Table 4 in the results chapter.

4 Results

The results of the study will be presented below regarding the three research questions and discussed subsequently. In the conclusions an outlook on further research is given.

Research question 1: What is the relationship between students' personal characteristics (enthusiasm and study satisfaction) and their use of the most relevant learning strategies and their attitudes towards online learning?

As shown in Table 2, students' enthusiasm and satisfaction with the previous regular university teaching (study satisfaction) correlate significantly in a medium range with their "effort" concerning learning and for students' enthusiasm a correlation with the regular 'use of literature' is significant in a small correlation. In line with these results, students' enthusiasm and study satisfaction show a large correlation with their appreciation of the materials provided online.

The strategies "general time management" and "online time management during online learning" do not correlate significantly with students' personal characteristics. The negative correlation coefficients between the uncertainty concerning study decision and students' "effort" and students' appreciation of the online materials are remarkable, although they are estimated as small. Further, students' personal characteristics show only small correlations with the preference for online learning and classroom learning, however, despite the small size, becoming significant for students' study satisfaction. The different signs in the correlation values, which are negative for the correlations with preference for classroom learning for two of the personal characteristics, are remarkable, even if the values have to be seen as small correlations. The preference for online learning correlates highly significant negatively with the preference for classroom learning with a negative Spearman correlation coefficient of about -.74.

Tab. 2. Spearman correlations rs between students' personal characteristics and selected learning strategies and the assessment of online learning (N = 71).

	General learning strategies					Assessment online learning			
	Literature use	Control	Effort	General time management	Planning	Appreciation material	Preference online learning	Preference classroom learning	Online Time management
Students' personal characteristics									
Enthusiasm/ Interest subject	.28*	.29*	.42***	-.06	.04	.53***	.25*	-.19	.08
Study satisfaction	.18	.16	.36**	.04	.19	.63**	.19*	-.22*	.08
Uncertainty concerning study decision	-.21	-.05	-.30**	-.17	.17	-.32**	-.08	.25*	-.04

Note. *p< 0.05 **p< 0.01.

Tab. 3. Spearman correlations rs of the general learning strategies with students' assessment of online learning (N = 71).

General learning strategies	Assessment of online learning			
	Appreciation material	Preference online learning	Preference classroom learning	Online Time management
Effort	.35**	.11	-.15	.08
General Time Management	.09	.11	-.25*	.19
Organisation	.25*	.08	-.03	.05
Literature use	.20	.27*	-.34**	.18
Peer assistance	-.22	-.23	.24*	-.16
Learning environment	.31**	.00	-.12	.03
Planning	.22	.11	-.07	.11
Regulation	.30*	.13	-.10	.16
Control	.25*	.22	-.24*	.23*

Note. *p< 0.05 **p< 0.01.

Research question 2: What is the relationship between students' general learning strategies and attitudes towards online learning?

As shown in Table 3, almost all of the general learning strategies correlate significantly at a small to medium range with the appreciation of the online learning materials. This concerns cognitive and resource management strategies as well as metacognitive learning strategies. Remarkably, all of the general learning strategies correlate negatively with preference for classroom learning, however, to a different extent (small to medium) and not in all cases significantly. Only one correlation is significantly negative with regard to the "preference for online learning". "general time management", the "use of literature" and "control" one's learning process" seem to be the most relevant learning strategies with regard to their correlation with a preference of online learning versus classroom learning. Looking at the correlations in the area of learning strategies among each other, we find significant correlations between the resource related strategy "effort" with the resource-oriented strategy "literature use" and 'learning environment' as well as with 'organisation' as a cognitive learning strategy and 'regulation' as a metacognitive learning strategy. Correlation coefficients are in the medium range from rs.=.32 to .47 (p< .001). It is noteworthy that the correlation between the 'general time management' strategies and the time management shown during the online learning period unexpectedly shows a small correlation of rs =.19. Possible explanations will be given in the discussion.

Research question 3: Which factors predict online learning preference versus classroom learning preference?

To get more information concerning predictors for online learning preference and classroom learning preference a hierarchical linear regression was conducted. As shown in the methods chapter above, the test on multicollinearity has excluded this. The values for the Durbin-Watson test are in a very satisfying range. Values for all models are reported in Table 4.

Tab. 4. Hierarchical regression analysis showing four models predicting a preference for online learning versus classroom learning

		Model 1 Online preference	Classroom preference	Model 2 Online preference	Classroom preference	Model 3 Online Preference	Classroom preference	Model 4 Online preference	Classroom preference
	$R^2{}_{adj.}$	.004	.018	.009	.127	.271	.269	.517	.459
	Durbin Watson	2.316	2.258	2.365	2.301	2.125	2.079	2.196	2.151
		β	β	β	β	β	β	β	β
Predictor variables									
Enthusiasm		.152	-.083	.031	.067	.071	.036	-.026	.122
Study satisfaction		.091	-.105	.057	-.134	.023	-.109	.123	-.198
Uncertainty study decision		-.008	.133	.049	-.031	.038	-.023	.107	-.084
General time management				.095 (.465)	**-.270** (.042)	-.010 (.920)	-.118 (.126)	-.092 (.363)	**-.281** (.011)
Peer assistance				**-.301** (.025)	.312 (.014)	-.187 (.112)	**.224** (.058)	-.170 (.076)	**.209** (.040)
Literature use				.170 (.273)	**-.324** (.028)	.116 (.382)	**-.283** (.037)	.053 (.623)	**-.288** (.052)
Control				.169 (.216)	-.213 (.098)	.088 (.455)	-.152 (.202)	.094 (.327)	-.157 (.125)
Planning								-.147 (.109)	**.269** (.029)
Online time management						**.527** (.000)	**-.402** (.001)	**.259** (.015)	-.164 (.140)
Fit university study with private life								**.589** (.000)	**-.521** (.000)

Note. Predicting variables were integrated in four steps resulting in 4 models each. Variables getting significant predictors at least for one model are presented. β beta coefficient. $R^2{}_{adj.}$coefficient of determination (adjusted). Significant and nearly significant predictors are printed in bold.

Model 1 tried to explain the preference for online learning versus classroom learning based only on students' personal characteristics. The values of $R^2{}_{adj}$ indicate, that the students' personal characteristics don't explain variance. Including the learning strategies in Model 2, at least for the preference of classroom learning the explained variance is satisfactory to a limited extent. Three general learning strategies explain the variance significantly for classroom learning, whereas for the prediction of preference of online learning, only one general learning strategy becomes significant with a negative value, the regular "peer assistance". A strong increase concerning the explained variance appeared in Model 3 when the time management concerning online learning and the appreciation of the online materials were included as predictors. While the appreciation of the online material has no significant predictor impact, the time management during the online learning period has opposite predictor effects, highly significant negative concerning classroom learning and highly significant positive concerning online learning. With about 27 % variance explained, Model 3 is a suitable regression model, when considering the explanation of variance. Nevertheless, we tried to explain some more variance and included one item in our regression Model 4 that maps the fit between private interests and university studies. As shown in Table 4, this predictor supersedes the predictor online time management from its prominent place. Also noticeable in this model is the fact, that all the general learning strategies get significant only concerning their impact on the preference of classroom learning (two of them significantly negative correlated). None of the general learning strategies predicts the preference for online learning in the Model 3 and the Model 4.

5   Discussion

The study aimed to clear up some factors correlating with and predicting a preference for further online learning and, respectively, the return to classroom learning for students effected by online teaching due to the pandemic. The relevance of learning strategies in the context of assessing online learning became apparent in several contexts.

Students' personal characteristics, their use of learning strategies and their attitudes concerning online learning
On the one hand, as expected, it was found that highly interested students and those who show a high study satisfaction so far also rated the learning strategy "effort" highly for themselves. Significant correlations were found with 'literature use' as learning strategy for a second resource-management learning strategy. These results are in accordance with Renninger (1992), Sebesta and Speth (2017), and Pintrich and Schrauben (1992), who found that students' interest in the content of tasks can influence their use of learning strategies. Lin, Zhang, and Zheng (2017) also found motivation as predictor of using learning strategies. Stark (2019) can confirm that students who reported stronger intrinsic motivation were more likely to use complex learning strategies.
However, the low correlations with the learning strategy "general time management" show that this relationship cannot be generalized for all resource-based learning strategies. With additional significant correlations with 'control' as a

metacognitive learning strategy it can be assumed that the highly interested students and students with a high study satisfaction show in general a promising learning behaviour that could be expected as a good predictor for the ability for self-regulated online learning. The high correlations of the student characteristics "enthusiasm" and "study satisfaction" with "appreciation material" possibly suggest an effect via the "effort" factor. Again, low correlations are shown between the students' characteristics and the time management shown during online learning. With regard to the preference for online learning versus classroom learning the correlations with students' characteristics were mostly not significant. But it is interesting, that the found correlations are positive for online learning while negative for classroom learning.

The role of learning strategies

As mentioned above, it could be assumed that general learning strategies have a different impact on students' ability for self-regulated learning and therefore possibly on their preference for online learning instead of classroom learning. While cognitive strategies can be assumed as personal characteristics rather independent from the learning context, self-regulated learning during online courses at university may be related to resource-management and metacognitive strategies to a greater extent. This assumption is supported by previous studies that show that resource-based learning strategies are more relevant in university than in high school (Schneider and Preckel, 2017). Self-regulated learners have to set goals and actively and constructively engage in their learning by adjusting their efforts, approaches and behaviors to achieve their learning goals (Boekarts and Corno, 2005; Sitzmann and Ely, 2011). Our study can confirm this assumption. The relevant learning strategies in this context as "effort", "general time management", "use of literature", designing the own "learning environment" and "control" of the own learning process correlate mostly significantly but all negatively with a preference for classroom learning. These results give hints that poorly developed general learning strategies may let students prefer the less self-regulated learning. Sebesta and Speth (2017) identified the concordant strategies concerning "literature use", "learning environment", "peer assistance" and "control" as the most used strategies by university students. The correlation coefficients for learning strategies and preference for online learning are not for all scales as high as for the preference for classroom learning, but, with one exception, all positive. The highest coefficients in this relationship are shown for resource-management related and metacognitive learning strategies. Sebesta and Speth (2017) also mention the need for university students to learn to manage their time and commitments and how to study independently. Moreover, Garcia and Pintrich (1994) point out the relevance of the non-cognitive strategies because these can help or hinder the student's effort. Binder, Waldeyer and Schmiemann (2021) name "effort" and "general time management" strategies as being relevant for university students. Lower than expected is the correlation between the 'general time management' learning strategy with the time management during online learning. It can be assumed, that the time management in the still new online learning is influenced not only by general time management strategies but also by other factors leading students to master their tasks. Concerning the prediction of academic success by time management, five of six studies found a significant positive relationship whereas two studies did not find a significant relationship (Broadbent and Poon, 2015).

Factors predicting a preference for online learning vs. classroom learning

With regard to correlative studies, it must be said that they do not permit causality statements. To clear up predictors for choosing online learning or classroom learning as the preferred way of learning we therefore conducted regression analyses. The first model with only the students' characteristics resulted in a not sufficient clearing up of the variance and this is in line with the low correlation between these variables. For the predictive impact of motivation (i.e. enthusiasm), other results could have been expected (Cassidy, 2011; Pintrich and De Groot, 1990).

Integrating the learning strategies, the $R^2_{adj.}$ is in an acceptable range for the classroom learning preference. With the learning strategy concerning "peer assistance", a resource related learning strategy has a significant predictor effect. It is noticeable that this effect is negative for online learning preference, while the predictor effect for 'use of literature' becomes negative for classroom learning. Here we can assume an opposing effect of learning with peers versus learning based on literature use. In the general context, 'general time management' is a significant negative predictor with regard to classroom learning, while it has almost no effect on the preference for online learning. 'effort' as a resource-management strategy is stated as relevant for study success and exam grades in the context of university studies (Schneider and Preckel, 2017), in our study with regard to the preference for online learning, it has no significant predictor effect.

Model 3 tried to clear up more variance by integrating the online-time management and appreciation of material as possible predictors for the preference of online learning versus classroom learning. Interestingly, $R^2_{adj.}$ increases significantly and for the preference of online learning all general learning strategies lose influence while for the preference of classroom learning two learning strategies still are significant predictors. However, time management during the online semester seems to have the greatest predictive effect for both dependent variables. Probably students' daily experienced success in the required self-regulation of the online learning expresses itself mostly in a successful time management during the online term, like the fit between learning requirements and the spent learning time. Exploratively, we conducted a fourth model integrating an item which expresses students' perceived fitting of the online learning with their private interests. The explained relevance continued to rise. With regard to the preference of online learning, none of the general learning strategies, but only the online time management, remain significant predictors beside the fit of study and private life. Only for the preference of online learning this variable is a positive predictor. We can assume that the better fit with students' private interests as experienced in the involuntary online learning period leads to a preference for this form of learning. Most remarkable is the fact that only for the preference of classroom learning four learning strategies are significant (one of them almost significant, two with a negative beta). Our results are confirmed by Sebesta and Speth (2017), who found a negative correlation between students' time management and their recourse to peer assistance. Research has shown that self-regulation is critical in determining students' successful learning experiences in an online learning environment (Cho and Kim, 2013). Our results can be interpreted in the way that a weak expression in the general learning strategies that become visible in negative beta coefficients significantly predict preference for classroom learning, because in students' perception less self-regulation may be required here. For predicting a preference for online learning general learning strategies seem to have a limited value. Successful mastering the requirements during the online term seems to be more relevant, independently from the expression of general learning strategies.

6   Limitations

There are some limitations for this study. Our instrument cannot meet all the criteria for a validated instrument, simply because of the small sample. But also some other validation steps could not be implemented. Nevertheless, our study gives good indications of aspects to be considered that are important for online learning. Therefore, our study should be considered as an exploratory study. Our exploratory approach aimed integrating students' motivation and their learning strategies in an instrument measuring their preference of online learning vs. classroom learning instead of measuring their learning outcome, which is investigated in a number of studies. Results should point out possibilities for support of students who need to attend in online learning. The number of participants (N = 71) is relatively low. However, approximately 40 % of the students in the course "Organic chemistry for non-major chemistry students" participated in the evaluation. During the term when our study was conducted there was no classroom learning which students could attend. Because of the COVID-19 pandemic, the students were forced to participate in online teaching. Comparisons with classroom learning were therefore not possible. The students had to rely on their memory of classroom learning they had before the pandemic situation. A comparison of two groups of students (one in an online course and the second in a classroom course) was also not possible. However, for such a comparison it should be ensured that there are no other differences than the teaching format. Because we used data from only one course some conformity can be assumed. However, the results of our study should be of interest for other teachers and researchers.

7   Conclusions and outlook

As discussed above, the questionnaire can be used for evaluating online courses if the interest of the researcher or practitioner includes correlations between learning strategies and personal characteristics and the teaching method. Further evaluations, especially of synchronous online courses are currently planned or have already been conducted. For these courses the data will be evaluated in due course.

For the teaching in online courses, SRL of students should be promoted as it is known that students can acquire and strengthen self-regulatory processes (Ley and Young, 2001; Lord, Diefendorff, Perels, Gürtler and Schmitz, 2005; Sebesta and Speth, 2017; Zimmerman, 2001). Sebesta and Speth (2017) conclude, that "therefore, students who do not possess a robust repertoire of self-regulated learning strategies may find navigating the road to success more challenging than expected". Our results show that resource-based learning strategies in particular need to be considered when implementing online teaching. Regardless of the quality of the online materials, it is important to ensure that students with poor learning strategies are provided with support that enables them to learn well in online formats. Particular attention should be paid to support in time management, advice on the use of literature and control of the learning process. Future research, for example, should include measures of motivation and attitudes toward learning that can help explain differences in strategy use and performance.

Providing an orientation prior to the beginning of the course could help students acclimatize to the course requirements, general resources, and software resources (Cho, 2012; Lee and Choi, 2011). For future research it would be interesting to use the questionnaire in an online course after promoting the students' SRL.

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