

Bachelor Thesis

Human Resource Development

LIFELONG LEARNING OF PROFESSIONALS: THE IMPORTANCE OF WORKPLACE LEARNING

Topic: Do people with preferred learning styles according to the Felder-Silverman learning style model learn in accordance with their learning style in the workplace on a daily basis?

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Abstract

Background

Companies use many resources to educate their employees and create specially designed training programs to train their employees. Considering and implementing individual preferred learning styles can improve motivation and job performance. Previous research has focused on the validity of learning style theories in regard to whether learning with a preferred learning style influences the final result and not on whether individuals with preferences for a learning style are learning in accordance with their preferred learning style on a daily basis in the workplace.

Aim of the study

The aim of this study is to answer the question of whether individuals learn in accordance with their preferred learning style on a daily basis in the workplace and if filling out the Index of Learning Styles, as well as the belief in learning styles, affects learning on a daily basis.

Methods

A diary study was created using the Twente Intervention and Interaction Machine (TIIM) measuring different factors. To answer the hypotheses, one question per dimension from the ILS was inserted into the diary study. The participants were divided into two groups, one group receiving the ILS on day 5 and the other on day 10. Participants were invited to take part in the survey by snowball sampling via social media and through the researcher's contacts. Participants working less than 20 hours a week were excluded from participation. A multilevel analysis was used to answer the question whether the participants learned in accordance with their preferred learning style and an independent samples test was used to find out if individuals were more likely to learn in accordance with their learning style after filling out the ILS at day 5, compared to the group filling out the ILS at day 10.

Results and Discussion

Partial support was found for the hypotheses that only individuals with a moderate or strong preference for the visual, verbal, global, sensing, and intuitive learning styles tend to learn in accordance with their learning. Furthermore, no significant difference was found between the group receiving the ILS at day 5 and the group receiving the ILS at day 10. The small sample size, the only satisfactory validity of the ILS and the study design influence the validity of this study. Nevertheless, it can be seen as a first step in exploring actual use of preferred learning styles in the workplace. Further studies with better study design and more advanced methods are needed to validate or refute these results.

1. Introduction

In a globalised world, regular adaptation of an individual's knowledge and behaviour is important to keep up with the competitive market. For this adaptation to take place, individuals need to learn. This learning is not limited to private or educational contexts but takes place in companies under the term workplace learning (Flåtén et al., 2015). Companies of various sizes use many resources to train their employees. In 2021, organizations spent an average of 63.9 hours on training per learner and spent \$1,071 per learner in the United States ("2021 Training Industry Report," 2021). Learning at the workplace could be aimed at adapting the behaviour of an employee in the interest of the company (Vaughan, 2008). As companies take an economically frugal approach to achieving the best possible efficiencies, improving the effectiveness of learning and training could help to reduce the costs associated with it. This can be achieved by adapting the training to the individual needs of the trainee in line with the goals of the company (Abdul Aziz & Selamat, 2016). One way to address these individual needs and enhance the effectiveness could be to consider individual learning styles when designing a learning program. People prefer to learn in different ways. Scientists have spent years researching learning styles, resulting in dozens of theories about different preferred learning styles. The best known of these are those of Honey and Mumford (1992), Kolb (1984) and Felder and Silverman (1988). The term "preferred learning style" is worth emphasizing because most theories have in common that learning styles are not fixed but are preferred methods of assimilating knowledge and that the success of learning can be negatively influenced using less effective learning methods. (Felder & Spurlin, 2005).

1.1 Workplace Learning

For understanding the study, understanding the background of different types of workplace learning and the different levels at which it takes place is relevant. Work-related learning can be described as the acquisition of knowledge, whether formal or informal, in the workplace. The distinction between formal and informal learning is important, however, as the former tends to be found in educational institutions and the latter dominates workplace learning (Eraut, 2004). Formal learning is described by individual, structured and the acquisition of explicit knowledge, while informal learning is mostly collaborative, and the acquired knowledge is less theoretical in nature, but experiential and focused on the completion of work-related tasks (Hager, 1998). However, in the digital and global world, informal learning is not enough to adapt to the ever-changing changes. Informal learning and thus also the unstructured and collaborative acquisition of knowledge, without guidelines, often takes place unconsciously and, due to the lack of guidelines, can also have negative effects, like bad habits, that do not

advance the company (Slotte et al., 2004). However, informal learning is a good opportunity to adapt flexibly and quickly to new circumstances and can take place constantly during the normal working day. Accordingly, companies should integrate informal learning to adapt to the fast-changing environments but should try to avert the potential undesired effects by trying to bring it in line with formal learning (Cacciattolo, 2015; Manuti et al., 2015).

Furthermore, there are differences in the different levels of learning, as workplace learning includes the terms individual learning, community learning, group learning, organizational learning, region learning and inter-organizational networks (Tynjälä, 2008). The focus of this paper will be on individual learning based on the consideration of learning styles without making a difference between formal and informal learning.

1.2 The Felder-Silverman Learning Style Model

The focus of this paper is on the Felder-Silverman learning style model (FSLSM), since the Index of Learning Styles (ILS) has acceptable reliability and good validity and is one of the most known models (Felder & Silverman, 1988; Platsidou & Metallidou, 2008). This model assigns the learner a preference on each of the four different dimensions sensing/intuitive, active/reflective, visual/verbal, and sequential/global based on their responses in the ILS (Felder & Spurlin, 2005). These preferences for the learning styles are mutually exclusive on each dimension, meaning that an individual can not have two preferences at the same time. For example, an individual with a preference for the visual learning style can not have a preference for the verbal dimension at the same time since both learning styles lie on the same visual-verbal dimension.

Sensing describes the preference for concrete facts and observation while intuitive refers to abstract theories and ideas. A learner with the preference for active likes to learn in groups and to participate actively, whereas reflective persons prefer individual and independent learning and thinking. Visual learners absorb information best in the form of pictures, graphs, or diagrams, while verbal learners prefer written or verbal communication channels to absorb and assimilate new information. The sequential/global dimension differs in the overall assimilation of information, as sequential learners follow a step-by-step process for assimilating and processing information, while global learners are better at acquiring information by building a big picture (Graf et al., 2007).

One study was able to prove that there are differences in job performance with different learning styles of managers. Managers with the intuition and global learning styles perform better than those with sensing and sequential (Malan-Rush & Waldo, 2015). These results suggest that managers with different learning styles perform differently, but not whether they

also learn in different ways on a daily basis, as this was not addressed in the study and the managers' performance was assessed by third parties. Thus, it could be that different learning styles lead to different performance, but whether perceived preferred learning styles are really preferred on a daily basis over other learning styles, remains to be investigated.

1.3 Research on learning styles

As with the Felder & Silverman model, the identification of most individual learning styles is accomplished by having individuals complete a questionnaire and then being assigned one or more learning styles, often on dimensions (Coffield, et al., 2004). The belief in learning styles is widespread in society, especially in educational institutions. For example, about 95% of preservice teachers in Turkey believe in the effectiveness of learning styles (Dündar & Gündüz, 2016). However, this belief in learning styles contradicts the scientific view that there is no evidence for the existence of learning styles (Willingham et al., 2015). It should be noted that individuals still have preferences for different learning methods and learn best in different ways, and some are also more effective than others, which is why learning styles are not considered fixed, but preferred, based on tendencies (Pashler et al., 2008; Newton & Salvi, 2020). In social research it has been clear for a long time that people should not be put into categories. When individuals, in the learning styles domain often students, are asked if and how they learn in different ways, different answers will confirm that there are individual preferences for different methods. This preference seems to exist, but there is no scientific evidence for different results when a test is administered (Riener & Willingham, 2010). Ultimately, however, tailoring a learning program to individual needs, considering preferred learning styles, can provide increased motivation and thus better results (Larkin & Budny, 2005; Zubaedi et al., 2021).

Although the use of the learning styles is mostly related to educational institutions such as schools, its application can also be beneficial in organizations. The application of the Index of Learning Styles has not yet been widely studied in relation to companies, but existing studies using different learning styles theories provide promising results in the assessment of learning styles in different organizations. For example, one intervention demonstrated improved teamwork, increased empathy and understanding, and reflection on one's own needs in relation to learning (Brix & Lauridsen, 2012). Furthermore, correlations between the application of learning styles and employee performance were found, and further research using other learning styles theories, such as the Felder-Silverman model, is recommended (Wahab & Puteh, 2021). Furthermore, a study among Japanese employees found differences in job confidence with

respect to different learning styles. These results could lead to a recommendation and implementation of other learning methods for better job performance (Yamazaki, 2012).

Despite the scientific opinion against learning styles in regard to the validity, considering the results that taking individual learning styles into account leads to increased motivation and thus improved results and that managers with different learning styles perform differently, the introduction of learning styles into corporate learning programs could nevertheless improve the efficiency of the training and job performance. Based on the low application of the Felder-Silverman model in companies and the successful application of other learning style theories, it remains open whether and to what extent the Felder-Silverman model is applicable in companies and whether the preferred learning styles based on the Index of Learning Styles are also applicable among employees.

1.4 Influence of questionnaires

Furthermore, it might be interesting to measure whether learning about one's own learning style already has an impact on the way one learns in the workplace on a daily basis. This effect of being influenced by the measurement itself has already been measured several times. One of these effects is called "Mere Measurement Effect" (MME) or "Question-behaviour effect" (QBE) and means that receiving a questionnaire including intentions can influence the behaviour of an individual (Godin et al., 2010; Wilding et al., 2016). This effect is already used as a cost-effective method to improve health behaviour of different groups (Voigt et al., 2020).

However, this effect only relates to intentions, so it might also be interesting to investigate whether actively reflecting on past processes or learning styles might have an impact on future learning. At the same time, it is also important to examine whether individuals believe in learning styles. For example, Nancekivell, et al. (2021) found that individuals who believe in the effectiveness of learning styles also support for example multimodal learning. Further, individuals who work with younger children are more likely to believe in the effectiveness of learning styles (Nancekivell et al., 2020).

1.5 The Present Study

The aim of this paper is to find out whether individuals with different learning styles based on the Felder-Silverman model learn differently on a daily basis in the workplace. Furthermore, it should be found out whether the awareness and belief of one's own learning style has an impact on perceived future learning, resulting in the following research questions and hypotheses.

Research Question 1: Does the preferred learning style of an individual influence the perceived learning on a daily basis in the workplace?

H1: Individuals with a preference for the visual dimension perceive to learn more often by observing how others did something in the workplace than by discussing something with others.

H2: Individuals with a preference for the verbal dimension perceive to learn more often by discussing something with others in the workplace than by observing how others did something.

H3: Individuals with a preference for the activist dimension perceive to learn more often by experimenting or testing something new in the workplace than by thinking things through.

H4: Individuals with a preference for the reflector dimension perceive to learn more often by thinking things through in the workplace than by experimenting or testing something new.

H5: Individuals with a preference for the sequential dimension perceive to learn more often by staying focused on one subject, learning as much about it as they can in the workplace than by making connections between a subject and related subjects.

H6: Individuals with a preference for the global dimension perceive to learn more often by trying to make connections between a subject and related subjects in the workplace than by staying focused on one subject, learning as much about it as they can.

H7: Individuals with a preference for the sensing dimension perceive to learn more often by using concrete materials (facts, data) in the workplace than by using abstract materials.

H8: Individuals with a preference for the intuitive dimension perceive to learn more often by using abstract materials (concepts, theories) in the workplace than by using concrete materials.

Research Question 2: Does becoming aware of one's own learning style affect learning on a daily basis?

H9: The scores of individuals filling out the Index of Learning Styles at day 5 of the study, will differ significantly compared to the scores of individuals filling out the Index of Learning Styles at the end of the study.

Research Question 3: Does believing in learning styles moderate the effect of the preferred learning style on learning on a daily basis in the workplace?

H10: The belief in learning styles moderates the effect of the preferred learning style on learning on a daily basis.

The results can then be used as fundamental research for further research into the effectiveness of learning styles in the area of workplace learning and companies can further increase the effectiveness of their learning programs, increase motivation and job performance and at the same time reduce the costs per learner through adapted learning methods.

2. Method

2.1 Design

An online diary study was used to measure learning on a daily basis. Learning on a daily basis was treated as the dependent variable and was examined by using the adapted online Structured Learning Report in a micro-longitudinal design, since the data on workplace learning on a daily basis was collected on 10 working days. The results of the Index of Learning Styles were used as the independent variables and measured cross-sectional. The study was treated as descriptive and experimental research with a between-subjects design, since the participants were randomly assigned to one of two groups, either receiving the Index of Learning Styles at day five or after day ten and both groups needed to fill out the diary study. Furthermore, a within-subjects design was used for hypotheses one to eight. The diary study was developed by combining multiple studies into one questionnaire that was administered daily. Ethical approval was granted from the Ethics Committee of the BMS faculty of the University of Twente.

2.2 Participants

A total of 28 individuals participated in the study, of which 18 participants completed the study to the extent and in sufficient detail that their responses were usable for this study. In total, 122 responses could be used. A majority of the participants come from the sports and fitness field, of which 14 are employed part-time, but work more than 20 hours a week, and 5 are employed full-time at the time of completing the study. The age of the participants ranges from 18 to 51, with an average age of 26. Most participants (61.1%) have at least completed high school and all participants live and work in Germany.

To assure that only employees working more than 20 hours a week could take part in the study, unemployed individuals, students and individuals with jobs, working less than 20 hours a week, were excluded from the study. If someone wanted to take part in the study and stated that they do not work more than 20 hours a week, they would be led to the last page of the study and thus excluded from completing the study. Since this study focuses on learning at the workplace, individuals who work less than 20 hours a week are not relevant for this study and can therefore be excluded due to more valid results. Participants were acquired using the

researchers' network through snowball sampling and in cooperation with a company from the fitness sector. They were invited with a link to participate via mail, social media, including WhatsApp and Instagram, or via the research members in person. Participants were only able to take part in the study if they have proficiency in English, to be able to fill in the questionnaire and understand the questions accordingly.

2.3 Materials

As a platform to distribute the survey, an application, called 'Twente Intervention and Interaction Machine' (TIIM) was used, an online survey tool for creating, administering, and processing questionnaires. The survey starts with informed consent and is followed by asking general questions regarding demographics, such as gender, age, nationality, current country of residence, current occupation, and educational degree. The survey consisted of a combination of various scales, but the focus of this research lies on the Index of Learning Styles.

The Index of Learning Styles was originally developed to identify students' preferences for different types of learning. For this purpose, individuals must answer a total of 44 questions, which are then rated according to a specific system, as shown in Appendix A, to determine the individual preference for a learning style on the respective dimensions in the 'mild', 'moderate' and 'strong' expressions. It is not possible to have no preference for one of the learning styles or to be neutral. Each score on each dimension can range from 1-11, with 1-3 representing a mild preference for a dimension, 5-7 moderate, and 9-11 strong. Scores 4 and 8 could not be achieved due to the nature of the ILS and scoring sheet (Appendix A).

The ILS has on average a satisfactory internal consistency, ranging from $\alpha = .41$ on the sequential-global dimension to $\alpha = .76$ on the sensing-intuitive dimension. In addition, the ILS has on average a satisfactory test-retest reliability, ranging from $r = .50$ on the sequential-global dimension to $r = .87$ on the visual-verbal dimension (Felder & Spurlin, 2005).

The questions contained in the daily questionnaires are based on the structured learning report by Endedijk et al. (2015). This structured learning report has a high internal consistency and satisfactory reliability (Endedijk et al., 2015). Four more questions were added to these questions to assess learning on a daily basis in relation to preferences for a particular learning style. A question was added for each dimension, which the participants had to answer every day, more specifically, questions 1 'I understand something better after I (a) try it out. (b) think it through.', 7 'I prefer to get new information in (a) pictures, diagrams, graphs, or maps. (b) written directions or verbal information.', 36 "When I am learning a new subject, I prefer to (a) stay focused on that subject, learning as much about it as I can. (b) try to make connections between that subject and related subjects.' and 38 'I prefer courses that emphasize (a) concrete

material (facts, data). (b) abstract material (concepts, theories).’ of the ILS were utilized and adapted to fit in with the design of the diary study, as these fit best into the design of the existing structured learning report, without making major changes to the question and thus influencing the measurement. Furthermore, the answer options were changed from ‘a’ and ‘b’ to a measurement on a 7-point-likert scale to give more variety in answering to give individuals the opportunity to indicate what they learned more often on each day, rather than exclusively (Appendix B).

2.4 Procedure

All questionnaires were provided via TIIM in an English version only. The study was distributed with a short link and a QR code via social media, including the messaging platform Whatsapp, Instagram and Facebook. Participants needed to create an account to participate. The study began with a short briefing, describing the study's purpose. Subsequently, the participants were informed that taking part is voluntary and that they could withdraw from it at any point in time. Confidentiality in the handling of data was guaranteed and in case of questions or remarks, the researchers' contact data were stated. Filling out the survey was only possible if the participants agreed to this informed consent.

At the beginning of the questionnaire, the participants were introduced to state their last three digits of their phone number and demographics. Participants who indicated that they worked less than 20 hours a week were redirected to the last page and excluded from taking part in the study. As the last step, the participants were thanked for their participation and reminded that they can contact the researchers for any comments or information regarding the study.

Participants were required to complete the structured learning report daily for the next 10 business days after the start. Participants were assigned to one of the two groups, called interventions, by the researchers and were then able to fill out the diary study. The diary study consisted of multiple items measuring workplace learning (Appendix B). If participants forgot to fill out the diary or did not work on one working day, they received a reminder, asking them to fill out the study.

After 5 days the first group had to fill in the Index of Learning Styles and the second group at the end of the 10 working days. Furthermore, at the end of the 10 working days and after successful completion of the Index of Learning Styles, the participants were asked whether they believed that individuals with different learning styles learn better in different ways.

3. Data Analysis

Subsequently to the collection of data by means of the questionnaire, the data was analysed by means of the statistical program SPSS to investigate to what extent the individual independent variables are associated with the dependent variable. Thus, the effects between the results of the Index of Learning Styles and learning on a daily basis will be investigated via multilevel modelling. Furthermore, to investigate a significant difference between the day-5 and day-10 group an independent samples t-test is used.

The survey data was imported from the TIIM application into the statistical programme SPSS. Subsequently, participants who did not complete the Index of Learning Styles were excluded using a command to ensure validity, resulting in 18 respondents. Furthermore, for the purpose of analysis and more valid data, the days of the individual participants were excluded from the analysis if no learning was indicated. Another participant was excluded from the analysis because all questions of the Index Of learning styles were answered with 'a'. The demographics as well as the ILS were measured cross-sectionally, whereas learning was measured on daily level.

To determine the preference for a learning style based on the Index of Learning Styles, a scoring sheet was used (Appendix A). The resulting scores indicated a mild (1-3), moderate (5-7) or strong (9-11) preference for a learning style.

These were then added to the dataset as four new variables with values ranging from '-3' to '3' for the individual preferences. Here, '3' is a strong preference for the first dimension, for example 'Active' and '-3' is a strong preference for the second dimension, in this example 'Reflective'.

The data was then prepared for the multilevel modelling. First of all, the dataset including cross-sectional data (person-level) was merged with the dataset including the measurement on a daily level (daily-level) to enable an analysis.

To test the first research questions with eight hypotheses, if the preferred learning style of an individual influences the perceived learning on a daily level, multilevel modelling was needed, since the data is hierarchically structured, with the daily scores on the four 7-point ILS questions being considered level-1 units and the data describing the participants, in this case the scores and therefore the preference on the ILS being the level-2 units (Gelman, 2006). Furthermore, the preference for the learning styles was grand-mean centred.

To prove the need for a multilevel model, the Interclass Correlation (ICC) was calculated by hand, based on the scores provided by SPSS. The results justified the need for a multilevel analysis for each dimension of the ILS, as seen in the results section.

Afterwards, dummies for the scoring categories on the ILS were created, resulting in 24 variables. Since the ILS variables were treated as categories, dummy coding was needed for the multilevel analysis (Yaremych et al., 2021). Based on the nature of the within-subjects design of the daily measurements, these dummies were then used for multilevel modelling, where the categories of both preferences on one dimension were compared to the mild category, based on the problematic nature of the ILS for not being able to not have a preference. Therefore, no comparison to a baseline was possible. The raw scores of the daily measurements were entered as the dependent variable and the preferences for the learning styles as the independent variables. For example, the mild preference of the visual category was compared to the mild, moderate, and strong preference of the verbal learning style and the moderate and strong preference of the visual learning style to determine potentially significant differences and thus whether participants differed in how they learned each day based on their preferred learning style. Thus, both hypotheses per dimension, for example hypothesis 1 and 2 for the visual-verbal dimension, could be answered by one analysis as both hypotheses of each dimension are pairs.

To answer the ninth hypothesis if the scores of individuals filling out the ILS in the course of the study differ significantly from the scores of the group that filled out the ILS at the end of the study, an independent samples t-test was used to determine if there is evidence that the means are significantly different between the group that received the ILS at day 5 and the group that received the ILS at day 10. Therefore, the participants were grouped according to the intervention they received and afterwards analysed, using the daily ILS learning scores as the testing variables.

Hypothesis 10, the possible moderation of the belief in learning styles on the effect of the preferred learning style on learning on a daily basis in the workplace could not be tested since only two out of 18 participants indicated no belief in learning styles, which would deliver invalid results based on the small sample size, which is why it was left out of the analysis.

4. Results

In order to improve the clarity and readability of the results, tables are inserted below when writing the results in text form could be too confusing due to the number of variables and categories.

4.1 Research Question 1

Does the preferred learning style of an individual influence learning on a daily basis in the workplace?

4.1.1 Hypotheses 1 & 2

The calculation of the ICC for the unconditioned visual-verbal dimension gives a moderate-high value of 0.514, that 51.4% of the variance of the visual-verbal dimension can be explained by the day level measurements (Musca et al., 2011). This shows that the scores of the visual-verbal dimension are not completely independent of the day level measurements and therefore justifies an analysis by a multilevel model.

Since both hypotheses on the respective dimensions are based on the same analyses, conclusions for both hypotheses can be drawn on this basis.

H1: Individuals with a preference for the visual dimension perceive to learn more often by observing how others did something in the workplace than by discussing something with others.

H2: Individuals with a preference for the verbal dimension perceive to learn more often by discussing something with others in the workplace than by observing how others did something.

A significant difference was found between the mild preference for the verbal learning style and the moderate preference for the visual learning style $F(1, 109) = 15.85, p < .001$. This difference could also be found in relation to the mild preference for the verbal learning style for the strong preference for the visual learning style $F(1, 109) = 46.48, p < .001$ and the strong preference for the verbal learning style $F(1, 109) = 8.13, p = .005$.

A second analysis comparing the individual preferences of the visual-verbal dimension with the mild preference for the visual learning style also identified significant differences to the moderate visual preference $F(1, 109) = 21.06, p < .001$, the strong visual preference $F(1, 109) = 54.95, p < .001$ and the strong verbal preference $F(1, 109) = 4.22, p = .042$.

This shows that individuals with a preference for the verbal learning style tend to score more negatively on the daily measurements of the ILS and thus are more likely to learn in accordance with their verbal preference. The results show that the difference from the respective mild preference for the visual and verbal learning styles are not significant. Hypotheses 1 and 2 can therefore only be partially confirmed, since only individuals with a moderate or strong preference for the verbal or visual learning style seem to tend to learn daily in accordance with their preferred learning style at their workplace.

Table 1

Multilevel analysis with mild preference for the visual learning style as comparison

Parameter	Std.				
	B	Error	t	Sig.	n
Intercept	5.190	.310	16.730	<.001	
Visual-Moderate	-1.878	.472	-3.981	<.001	3
Visual-Strong	-2.820	.414	-6.817	<.001	4
Verbal-Mild	.336	.450	.746	.457	3
Verbal-Moderate	.810	.502	1.613	.110	2
Verbal-Strong	1.283	.450	2.851	.005	2

Table 2*Multilevel analysis with mild preference for the verbal learning style as comparison*

Parameter	Std.				
	B	Error	t	Sig.	n
Intercept	5.526	.326	16.943	<.001	
Visual-Moderate	-2.214	.482	-4.589	<.001	3
Visual-Strong	-3.156	.426	-7.413	<.001	4
Verbal-Moderate	.474	.512	.926	.357	2
Verbal-Strong	.947	.461	2.054	.042	2
Visual-Mild	-.336	.450	-.746	.457	3

4.1.2 Hypotheses 3 & 4

The calculation of the ICC for the unconditioned active-reflective dimension gives a high value of 0.356, which means that 35.6% of the variance of the active-reflective dimension can be explained by the day level measurements and the probability for a Type I error is increased (Musca et al., 2011). This shows that the scores of the active-reflective dimension are not independent of the day level measurements and therefore justifies an analysis by a multilevel model.

H3: Individuals with a preference for the activist dimension perceive to learn more often by experimenting or testing something new in the workplace than by thinking things through.

H4: Individuals with a preference for the reflector dimension perceive to learn more often by thinking things through in the workplace than by experimenting or testing something new.

As can be seen in Tables 3 and 4, no significant differences were found between the individual preferences of the Active-Reflective dimension in terms of learning on a daily basis. Only a marginally significant difference can be found between the mild preference for the reflective learning style and the moderate preference for the reflective learning style $F(1, 16.12) = 3.94, p = .065$. This means that hypotheses 3 & 4 can be rejected, since individuals with a preference for one dimension do not learn significantly differently compared to other participants with other preferences.

Table 3

Multilevel analysis with mild preference for the reflective learning style as comparison

Parameter	Std.		t	Sig.	n
	B	Error			
Intercept	3.533	.530	6.666	<.001	
Active-Mild	-.640	.790	-.811	.428	5
Active-Moderate	.752	.904	.832	.417	3
Active-Strong	-1.596	1.028	-1.552	.140	2
Reflective-Moderate	2.092	1.354	1.544	.142	1
Reflective-Strong	0	0	.	.	0

Table 4

Multilevel analysis with mild preference for the active learning style as comparison

Parameter	Std.		t	Sig.	n
	B	Error			
Intercept	2.893	.586	4.939	<.001	
Active-Moderate	1.393	.938	1.485	.155	3
Active-Strong	-.955	1.058	-.903	.380	2
Reflective-Moderate	2.732	1.377	1.984	.065	1
Reflective-Strong	0	0	.	.	0

Reflective-Mild	.640	.790	.811	.428	6
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4.1.3 Hypotheses 5 & 6

The calculation of the ICC for the unconditioned sequential-global dimension gives a high value of 0.317, which means that 31.7% of the variance of the sequential-global dimension can be explained by the day level measurements with a higher probability for a Type I error (Musca et al., 2011). This shows that the scores of the sequential-global dimension are not independent of the day level measurements and therefore justifies an analysis by a multilevel model.

H5: Individuals with a preference for the sequential dimension perceive to learn more often by staying focused on one subject, learning as much about it as they can in the workplace than by making connections between a subject and related subjects.

H6: Individuals with a preference for the global dimension perceive to learn more often by trying to make connections between a subject and related subjects in the workplace than by staying focused on one subject, learning as much about it as they can.

The multilevel analysis of the sequential-global dimension shows significant differences between the mild preference for the global learning style and the strong preference for the global learning style $F(1, 14.98) = 4.53, p = .050$.

Performing a second analysis comparing the individually expressed preferences for the sequential-global dimension with the mild preference for the sequential learning style confirmed the result by identifying a significant difference in terms of the moderate preference for the global learning style $F(1, 19.24) = 6.77, p = .017$ and the strong preference for the global learning style $F(1, 16.72) = 11.97, p = .003$.

These results show that individuals with a preference for the global learning style are more likely to use it for learning on a daily basis in the workplace. The multilevel analysis showed that, similar to the first two hypotheses, individuals tend to learn more in accordance with their preferred global learning style if they have at least a moderate preference for it. Since the results show that there is no significant difference to the mild category, hypothesis 6 can only be partially confirmed, since it originally assumes that individuals with a general tendency for one or the other learning style learn in accordance with it, regardless of the strength of the preference. No significant difference was found for the sequential learning style, so hypothesis 5 must be rejected.

Table 5

Multilevel analysis with mild preference for the global learning style as comparison

Parameter	B	Std.		Sig.	n
		Error	t		
Intercept	3.571	.919	3.888	.001	
Sequential-Mild	-.148	1.030	-.144	.887	5
Sequential-Moderate	0	0	.	.	0
Sequential-Strong	-1.360	1.126	-1.208	.245	2
Global-Moderate	1.400	.990	1.413	.177	6
Global-Strong	2.234	1.049	2.129	.050	3

Table 6

Multilevel analysis with mild preference for the sequential learning style as comparison

Parameter	B	Std.		Sig.	n
		Error	t		
Intercept	3.423	.466	7.346	<.001	
Sequential-Moderate	0	0	.	.	0
Sequential-Strong	-1.212	.801	-1.513	.148	2
Global-Moderate	1.548	.595	2.603	.017	6
Global-Strong	2.382	.688	3.460	.003	3
Global-Mild	.148	1.030	.144	.887	1

4.1.4 Hypotheses 7 & 8

The calculation of the ICC for the unconditioned sensing-intuitive dimension gives a high value of 0.321, which means that 32.1% of the variance of the sensing-intuitive dimension can be explained by the day level measurements (Musca et al., 2011). This shows that the scores of the sensing-intuitive dimension are not independent of the day level measurements and therefore justifies an analysis by a multilevel model.

H7: Individuals with a preference for the sensing dimension perceive to learn more often by using concrete materials (facts, data) in the workplace than by using abstract materials.

H8: Individuals with a preference for the intuitive dimension perceive to learn more often by using abstract materials (concepts, theories) in the workplace than by using concrete materials.

The multilevel analysis for hypotheses 7 and 8 shows significant differences between the mild preference for the intuitive learning style and the moderate preference for the sensing learning style $F(1, 13.35) = 7.45, p = .017$. Furthermore, there is a significant difference between the strong preference for the intuitive learning style and mild preference for the intuitive learning style $F(1, 11.59) = 5.91, p = .032$. It is important to mention the marginally insignificant difference to the strong preference for the sensing learning style $F(1, 12.53) = 4.66, p = .051$.

This borderline insignificant difference is a significant difference in the second analysis when compared to the mild preference for sensing learning style $F(1, 14.97) = 5.12, p = .038$. Furthermore, the results from the first analysis could be confirmed with a significant difference to the moderate preference for the sensing learning style $F(1, 17.64) = 8.23, p = .010$ and to the strong preference for the intuitive learning style $F(1, 12.95) = 5.39, p = .037$.

As already seen in hypotheses 1, 2 and 6, these results also show a significant difference to the mild preference, in this case of the two learning styles sensing and intuitive. However, this significance is again only evident for the moderate preference for the sensing learning style and the strong preference for the intuitive learning style. Moreover, the first analysis shows borderline no significant difference in the strong preference for the sensing learning style compared to the mild preference for the sensing learning style. Moreover, the difference becomes less significant when an individual's preference for the sensing learning style exceeds moderate. This leads to the conclusion that hypothesis 7 can only be accepted if we assume that only individuals with a moderate preference for the sensing learning style tend to learn in accordance with their learning style. Hypothesis 8 also cannot be conclusively confirmed because only individuals with a strong preference for the intuitive learning style tend to apply it on a daily basis in the workplace.

Table 7

Multilevel analysis with mild preference for the intuitive learning style as comparison

Parameter	B	Std. Error	t	Sig.	n
Intercept	3.897	.501	7.776	<.001	
Sensing-Mild	.098	.712	.138	.892	4
Sensing-Moderate	-1.739	.637	-2.729	.017	5
Sensing-Strong	-1.686	.781	-2.159	.051	2
Intuitive-Moderate	1.120	.755	1.483	.166	2
Intuitive-Strong	2.353	.968	2.430	.032	1

Table 8

Multilevel analysis with mild preference for the ensuing learning style as comparison

Parameter	B	Std. Error	t	Sig.	n
Intercept	3.995	.505	7.904	<.001	
Sensing-Moderate	-1.837	.641	-2.868	.010	5
Sensing-Strong	-1.785	.784	-2.277	.038	2
Intuitive-Moderate	1.022	.758	1.348	.201	2
Intuitive-Strong	2.255	.971	2.323	.037	1
Intuitive-Mild	-.098	.712	-.138	.892	3

4.2 Research Question 2

Does becoming aware of one's own learning style affect learning on a daily basis?

4.2.1 Hypothesis 9

The scores of individuals filling out the Index of Learning Styles at day 5 of the study, will differ significantly compared to the scores of individuals filling out the Index of Learning Styles at the end of the study.

The independent samples test showed no significant differences between the group receiving the ILS at day 5 and the group receiving the ILS at day 10 on all dimensions (Table 9). Completing the ILS and becoming aware of one's preference for a learning style of the respective dimensions has no significant effect on future learning on a daily basis in the workplace. Thus, hypothesis 9 can be rejected and no 'Mere Measurement Effect' or 'Question-Behaviour effect' could be found in this sample.

Table 9

Independent samples test with learning styles as dependent variable and control and experimental group as independent variables

Dimensions	t	df	Sig. (2-tailed)
Visual-Verbal	.190	15	.852
Active-Reflective	-1.270	15	.223
Sequential-Global	-.843	15	.413

Sensing-Intuitive	.548	15	.592
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5. Discussion

5.1 Discussion of results

Previous studies have focused on the effectiveness of learning styles in terms of test scores (Willingham et al., 2015; Li et al., 2016). Here, no significant differences were found between preferred and randomized learning methods based on learning styles in terms of outcomes. However, it has not yet been investigated whether individuals with preferred learning styles actually apply them in their daily lives and, related to this study, in their daily work. This study aimed to answer the question of whether learning on a daily basis in the workplace is influenced by an individual's preferred learning styles based on the Index of Learning Styles from the Felder-Silverman model and if the individuals learn in accordance with their learning style.

It was found that only individuals with a preference for the visual, verbal, global, sensing, and intuitive learning styles tend to learn in accordance with their learning style if they have a specific preference for it. The stronger the preference for the visual, verbal or global learning style, the more likely a participant in this study learned in accordance with that learning style on a daily basis. Only individuals with a moderate preference for the sensing learning style and individuals with a strong preference for the intuitive learning style tend to learn in accordance with it. Thus, hypotheses 1, 2, 6, 7 and 8 can at least be partly confirmed, while hypotheses 3, 4 and 5 were rejected.

Furthermore, this study aimed to answer whether becoming aware of one's own preferred learning styles by completing the Index of Learning Styles on day 5 of the study influences the way of learning in the following days, i.e., whether the participants subsequently learn more in accordance with their learning style. An independent samples test could not detect a significant difference and therefore hypothesis 9 was rejected. This means that the scores of the participants who filled out the ILS during the course of the study did not differ significantly from the scores of the group that filled out the ILS at the end of the study and the possibility of an Mere Measurement Effect can be rejected, since filling out the ILS does not seem to have an effect on the scores.

Finally, it should also be answered whether the belief in learning styles moderates the effect of learning styles on learning on a daily basis. This question could not be answered due to the small sample size of usable responses (n=18), as only two participants indicated not believing in learning styles and the results of an analysis would most likely be invalid due to

errors (Akobeng, 2016). If an analysis would be performed with only two persons as comparison, these results could already change by adding another person. These results nevertheless show that the majority of the participants in this sample (89%) believe in learning styles. This replicates the results from other authors that many individuals still believe in learning styles (Dekker & Kim, 2022).

5.2 Strengths and limitations

One major strength of this study is the collection of data in the form of a diary study, capturing learning behaviour over a span of 10 working days and in this case, concluding in 122 data points. One advantage of diary studies is the possibility of subdividing within-person and between-person data (Pindek et al., 2018). Moreover, by applying diary studies in this study, the behavioural patterns related to learning can be entered right after work or close in time, and by using the reminder, can reduce the likelihood of biases or forgetting and therefore increase the validity of the results (Beal, 2015).

Nevertheless, the results of this study are affected by the not very high reliability of the Index of Learning Styles. This low reliability is mainly reflected in the two dimensions active-reflective and sequential-global. Based on four studies, these have on average the lowest reliability ($\alpha=.57$, $\alpha=.50$) compared to the dimensions visual-verbal ($\alpha=.62$) and sensing-intuitive ($\alpha=.71$) (Felder & Spurlin, 2005).

Furthermore, the choice of learning materials did not open the possibility for a free choice of the way of learning, thereby forcing the participants to learn in a way different from the one they preferred. This may also be due to the nature of the working sector as most of the participants come from the fitness sector, but further investigations into different working sectors are necessary for an answer to this problem. Furthermore, only one question per dimension per day was included in the TIIM application, so there is a possibility that the questions included are not representative for the whole dimension. This means that using other or additional questions could change the results, since Felder and Silverman (1988) designed 11 questions per dimension to capture the entire dimension of learning styles. Thus, it is possible that the questions selected for this paper look at only a portion of the dimensions.

Another limitation is the dissemination of the survey since it was conducted via social media and through the contacts of the researcher. Thus, mainly people working in the fitness sector, with a similar education and possibly similar attitude towards learning were studied. This can affect the variety of participants and thus the results (Baltar & Brunet, 2012). Individuals in other work sectors may have a different selection of materials to learn or a greater mix of theory and practice may be present, as in craftsmanship, which could influence the

measurement of preferred learning style (Chan, 2014). This could also be one of the reasons for only having two people that do not believe in learning styles.

It should also be noted that the survey was conducted in English instead of German, although all participants were working and living in Germany, which may cause a certain language barrier and thus also affect the validity. After the end of the study, two participants also contacted the researchers and, despite the informed consent, expressed their concerns about the anonymity of their data and the use of their data by their supervisors, as they had to register with their email in the TIIM app in order to participate in the study. For fear that the given data are visible for the own superiors, socially desirable answers could have been given in order not to endanger the own position in the job (Kwak et al., 2021).

Contrary to the expectation of hypothesis 9 that the completion of the ILS would influence future learning in accordance with the respective learning style, this effect could not be found. The original purpose of this question was to investigate whether the mere measurement effect can also occur through active reflection on behaviour in questionnaires. So far, the Mere Measurement effect has only occurred in relation to questionnaires that measure future intentions, and this study could not disprove this, as no significant effect could be found (Wilding et al., 2016).

Another limitation is the lack of a neutral reference, or the impossibility of having no preference for a learning style. Thus, the respective strengths of the individual preferences of a learning style on one dimension had to be compared with the mild category of the other learning style in the multilevel analysis. This could limit the accuracy of the results.

Finally, the low number of usable responses from 18 participants also influences the results of this study, since smaller sample sizes can affect the standard errors as well as the probability of Type I and Type II errors and the generalizability of results (Scherbaum & Ferreter, 2008; McNeish & Stapleton, 2014). Although the diary study yielded 122 usable data points, these came from only 18 participants, divided into up to six different categories, or preferences per learning style (mild, moderate, strong per learning style per dimension), so that the validity of these results can be questioned (Tables 1-8). In Table 6, for example, with six participants the highest number of participants in one category can be seen, but therefore there are no results in the category sequential-moderate and less entries in the remaining preferences. As already mentioned in the discussion about the missing analysis of the belief in learning styles, the results from few participants might not be valid, since the addition of already one or two persons could strongly influence and change the results (Akobeng, 2016). Among other things, the study design could be responsible for this, since participants first had to download

the TIIM app, register, enter a code, and then wait for approval to answer questions over a period of 10 working days. The number of steps to complete and the lack of rewards for participating may have negatively influenced the motivation of potential participants and may have been responsible for the small sample size (Edwards, 2002; Keusch, 2015).

5.3 Future research

Future studies could focus on improving the validity and reliability through a better study design with fewer barriers and a correspondingly larger sample size and more time to evaluate change and by adding more questions per dimension to validate or refute the present results, as there is no study so far that has focused on this question about learning on a daily basis based on the preferred learning styles. For this reason, there are currently no studies with which to compare these results. More specifically, this study should be conducted in the native language of the participants to avoid a possible language barrier. In addition, the time period should be significantly extended in order to observe possible behavioural change in regard to changing and maintaining the way of learning, as this may take time (Lally et al., 2009; Limayem & Cheung, 2011). This could be used to check again if the completion of the ILS does not lead to a change in learning on a daily basis, as a period of 5 days after completion of the ILS might be too short in terms of generalizability.

It could also be interesting to use the same study design with different learning theories to check for differences or similarities, for example Kolb's learning style theory (Cornwell & Manfredi, 1994). It is one of the most known and used learning style theories (Jebbari et al., 2022). The results of this study relate only to learning on a daily basis in the workplace in terms of the Index of Learning Styles. The application of a different learning theory, which may have already been established and validated more frequently in companies, could produce different results. The problem with learning theories, such as the Felder-Silverman model, is that they are not adapted for corporate use, but were originally designed for engineering students (Felder & Spurlin, 2005). Thus, the use or even the development of a learning theory adapted to companies could lead to more valid results and also to new insights in terms of learning in the workplace.

Furthermore, a different type of distribution of the study should be chosen, such as simple random sampling, to obtain a significantly larger spectrum of responses from different populations, since a large part of the responses in this study came from people working in the fitness sector. By using different sample methods, the sample size and thus the accuracy of the results could be increased (Taherdoost, 2016).

It would also be of interest to focus only on individuals who do not believe in learning style theories to provide results for hypothesis 10, which could not be answered in this study. For this purpose, a study design with an experimental group consisting of participants who do not believe in learning styles could be focused on and the results compared. However, this problem can also lie in the general nature of the belief in learning styles, since, as described above, many still believe in learning styles, and it can therefore be more difficult to find participants who do not share this attitude towards learning styles.

5.4 Conclusion and Implications

This study aimed to answer the questions whether individuals learn in accordance with their learning style on a daily basis in the workplace and whether the completion of the ILS, as well as the belief in learning styles, have an influence on the way of learning. In doing so, the results of the multilevel model found significant differences in the individual preferences of learning styles when compared to the mild category of the other learning style on the same dimension, such as verbal-visual. Thus, it was found that individuals with a moderate or strong preference for the verbal, visual, or global learning style tend to learn in accordance with it, that only individuals with a moderate preference for the sensing learning style learn in accordance with it, and that only individuals with a strong preference for the intuitive learning style learn in accordance with their preferred learning style. However, this also shows that hypotheses 1, 2, 6, 7 and 8 could not be conclusively confirmed or rejected, since individuals only learn in accordance with their learning style if they have a moderate or strong preference for it, but not a mild. Hypotheses 3, 4 and 5 could be rejected. In addition, no significant difference was found between the scores of the group that received the ILS on day 5 and the group that received the ILS on day 10, rejecting hypothesis 9. The question of whether the belief in learning styles moderates the effect of the preferred learning style on learning on a daily basis could not be answered due to the fact that only two subjects did not believe in learning styles. This paper has also shown that it can make sense to review learning styles in the company in order to adapt the learning materials and provide each employee with a wide range of learning opportunities. Based on this paper, this does not apply to the active-reflective dimension and the sequential learning style, but companies should provide their employees with different learning materials to promote the best possible learning and potentially improve motivation as well as job performance. (Larkin & Budny, 2005; Yamazaki, 2012; Zubaedi et al., 2021). Apart from the problems of this study, the results can be seen as a first step in a new direction of research on learning styles, which to the best of our knowledge has not yet been addressed.

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7. Appendix

Appendix A

Scoring Sheet of the Index of Learning Styles

Learning Styles Questionnaire Scoring Sheet

- Place a "1" in the appropriate spaces in the table below (e.g. if you answered "a" to Question 3, put a "1" in Column "a" by Question 3).
- Add up the columns and write the totals in the indicated spaces.
- For each of the four scales, subtract the smaller total from the larger one. Write the difference (1 to 11) and the letter (a or b) with the larger total.

Activist/Reflector			Sensing/Intuitive			Visual/Verbal			Sequential/Global		
Q	a	b	Q	a	b	Q	a	b	Q	a	b
1			2			3			4		
5			6			7			8		
9			10			11			12		
13			14			15			16		
17			18			19			20		
21			22			23			24		
25			26			27			28		
29			30			31			32		
33			34			35			36		
37			38			39			40		
41			42			43			44		
<i>Total (add up each column)</i>											
Activist/Reflector			Sensing/Intuitive			Visual/Verbal			Sequential/Global		
Q	a	b	Q	a	b	Q	a	b	Q	a	b
<i>Larger – Smaller + Letter of Larger (see below*)</i>											

**Example: If your total was 3 for a and 8 for b: 8 – 3 = 5, b is letter of larger so you would enter 5b.*

Explanation of scores

- If your score on a scale is 1-3, you have a mild preference for one or the other dimension but you are essentially well balanced.
- If your score on a scale is 5-7, you have a moderate preference for one dimension of the scale and will learn more easily in a teaching environment which favours that dimension.
- If your score on a scale is 9-11, you have a strong preference for one dimension of the scale. You may have real difficulty learning in an environment which does not support that preference.

Appendix B**Diary Study****Daily Questionnaire (workdays)**

	<p>Hello,</p> <p>Thank you for taking part in Day 1 of this Diary Study.</p> <p>The following questions will take only 5 minutes of your time.</p>
1	Please fill in the last three digits of your phone number.
2	Today I learned from my work. (Likert 1-5)
3	Can you recall something that you learned today from work? (Yes/No)

4	What did you learn from work?
5	<p>Choose the activity/activities through which you learned.</p> <p>I learned by... (multiple answers possible)</p> <p>Experiencing or doing something</p> <p>Reflecting on my work experiences</p> <p>looking up information (book, internet)</p> <p>observing how others did something</p> <p>discussing something with others</p> <p>seeking help or information from others</p> <p>participating in a workshop, training or course</p> <p>other</p> <hr/> <p>Today, I learned mainly by...</p> <p>1) Looking at visuals (video, picture, illustration, graphs...)</p> <p>2)</p> <p>3)</p> <p>4) Both equally</p> <p>5)</p> <p>6)</p> <p>7) Reading text or listening</p> <p>Today, I learned mainly by...</p>

	<p>1) Trying things out</p> <p>2)</p> <p>3)</p> <p>4) Both equally</p> <p>5)</p> <p>6)</p> <p>7) Thinking things through</p> <p>Today, I learned mainly by...</p> <p>1) Staying focused on one subject, learning as much about it as I can</p> <p>2)</p> <p>3)</p> <p>4) Both equally</p> <p>5)</p> <p>6)</p> <p>7) Trying to make connections between the subject and related subjects</p> <p>Today, I learned mainly by...</p> <p>1) Using concrete materials (facts, data)</p> <p>2)</p> <p>3)</p> <p>4) Both equally</p> <p>5)</p> <p>6)</p> <p>7) Using abstract materials (concepts, theories)</p>
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6	<p>What other people were involved in this activity?</p> <p>(Multiple answers possible)</p> <ul style="list-style-type: none">-A colleague from my workplace/organisation-A colleague outside my workplace/organisation-My superior-A customer, client or user of my product or service-Other-No other people were involved
7	<p>Did you plan to learn this?</p> <p>Yes</p> <p>Not for this moment specifically, but I had the intention to learn this</p> <p>No</p>
8 (if 7 = yes OR intention)	<p>What was the main reason to learn this?</p> <p>Choose the description that fits best with your learning moment.</p>

	<p>I was unsatisfied with an earlier experience</p> <p>I wanted to practice something</p> <p>I wanted to prepare myself for future situations</p> <p>Out of curiosity</p> <p>Others stimulated me to develop myself in this</p> <p>It was necessary for my role in the team</p>
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