May online blended learning in corporate training enhance lifelong learning? Experiences from Artificial Intelligence courses for professionals

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Abstract— **This Work in Progress paper presents an ongoing study of blended learning approaches applied to Artificial Intelligence (AI) online courses in professional education. Online learning events have gained significant importance as companies and individuals are increasingly required to engage in lifelong learning and capacity building. Still, factors that enhance or hinder professionals' ability to take on lifelong learning through education and put new knowledge into practice are underexplored. We present our conceptual framework and research design based on well-developed theoretical and operationalized concepts from cognitive, meta-cognitive and motivational theories of learning. The expected results reveal key factors affecting individuals learning in online corporate training and their implications for educational practice.**

Keywords— lifelong learning, online blended learning, cooperate training

I. INTRODUCTION (*HEADING 1*)

The rapid development and affordability of information technology and the internet has open new possibilities for adult education and lifelong learning. Educational institutions such as universities put increasing efforts into enhancing traditional classroom teaching with distance and blended forms of teaching and learning by experimenting with different combinations of synchronous and asynchronous learning activities online and in-class. Those efforts have resulted in new pedagogical models such as the flipped classroom [1].

A similar trend can be observed in the corporate world as companies and individuals are increasingly required to engage in lifelong learning and capacity building, particularly related to ongoing developments in digitalization, the rise of Massive Open Online Courses (MOOCs) and the industry 4.0 [2].

While there are numerous case studies and some review papers on blended learning in formal engineering education [3][4][5], there is a paucity of research evaluating blended learning designs in the context of professional education and lifelong learning [2]. More, as the situation in society now calls for increasing and rapid response by universities to provide education as a part for lifelong learning it has become increasingly important to find models that make corporate training readily available on demand.

Existing research on online learning in corporate settings has identified a number of benefits in terms of flexibility, time and cost efficiency, employee and customer satisfaction, and personalized and self-regulated learning [6][7][8][9]. These positive outcomes are all sought after in education of practitioners as a part of lifelong learning. However, the approach tends to put higher demands on development and maintenance requirements of courses and the technology literacy of the participants. Reported problems with online learning also include technology issues, educational quality, interactivity and organisational support [7][9][10].

While there is rich landscape of research in the context of e-learning (see for example [11] for a recent review), research about online learning in corporations in the context of lifelong learning is still limited, particularly with regard to factors like employee expectations, motivations and learning strategies, contextual factors such as organisational and peer support as well as work-life conflicts, blended learning effects and long term transfer [2, 12].

This study aims to contribute to this research on online-based corporate training by examining three online courses using different blended learning concepts covering topics related to Data Science and AI. The main target group are engineers from diverse fields, with basic knowledge in mathematics, statistics and programming. The participants come from both private companies and public organizations, while all instructors are active researchers at a Swedish Technical University. We analyse the efficacy of the online classroom and the blended learning approach with a particular focus on learner characteristics, contexts factors, and long-term results. Our research question is:

What factors enhance or hinder professionals' ability to take on lifelong learning through education and put new knowledge into practice?

In this paper, we develop and present our conceptual framework and research design based on well-developed theoretical and operationalized concepts from cognitive, meta-cognitive and motivational theories of learning.

II. THEORETICAL FRAMEWORK

Our approach is mainly characterized by an attempt to integrate three influential conceptual frameworks – Biggs' student approaches to learning (SAL) as conceptualized through the 3P- (presage, process, product) model [13], Pintrich's work on motivation and self-regulated learning (SRL) operationalized through the Motivated Strategies for Learning Questionnaire (MSQL) [14] and Kirkpatrick's Training Evaluation Model [15]. By doing so, we stress the importance of individual factors, but also teaching and

organizational context as well the actual learning process to explain the short- and long-term learning outcomes.

While all three frameworks come from different research communities and traditions, they show a number of similarities and complement each other in their differences. Biggs 3P model and Pintrich's model are very similar in their structure and share assumptions about the importance of active learning, the personal and contextual influences on the learning process, the interaction between cognition and motivation/affect. They both provide well-developed and tested scales for measurement [16].

Biggs identified three general approaches to learning: *surface learning* characterized by an instrumental motive to minimize efforts to pass a course, *deep learning* motivated through a sincere interest in the topic, and *strategic learning* as the attempt to find an optimal combination of the other two learning approaches to achieve high grades. The 3P-model of general learning (Fig. 1) emphasizes "the adaptive role of a deep approach to learning and explicated how these processes are guided by both personal and situational factors." [16, p 308]. We use the 3P model as the overarching framework for our analysis including a condensed version of the Revised Two-Factor Study Process Questionnaire (R-SPQ-2F) [17] to account for the learners' approaches to learning in the different courses. However, the 3P model lacks tools to measure aspects such as SRL, technology literacy and transfer intentions, justifying the inclusion of the additional scales.
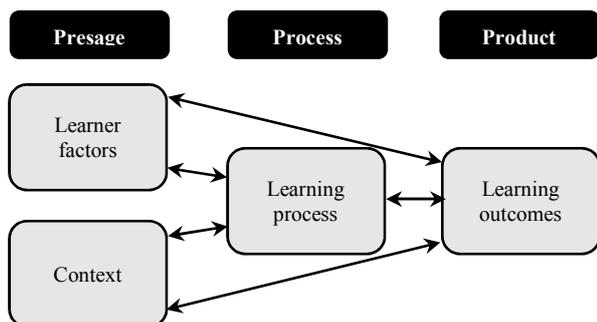

Fig. 1.   Biggs 3P model (adapted from [13])

SRL stems from a social-cognitive perspective on motivation and learning strategies [18] and stresses the need for learners to regulate their cognition, motivation and learning habits. Thus, learning outcomes are assumed to be heavily influenced by both motivational and self-regulatory processes and moderated by personal learner characteristics (such as age and gender) as well as contextual factors. Learners with higher SRL skills are more likely to achieve deeper levels of learning [16]. To measure motivation the MSLQ relies on three general constructs containing several subcontracts: (1) expectancy with the subconstructs self-efficacy and Control of Learning Beliefs; (2) value with the subconstructs intrinsic and extrinsic goal orientation as well as task value beliefs; and (3) affect with the subconstruct task anxiety. With regard to learning strategies, the MSLQ uses four constructs: (1) Cognitive strategies with the subconstructs rehearsal, elaboration and organization strategies as well as critical thinking; (2) Metacognitive strategies as one construct relating to planning, monitoring and regulating; (3) Resource management consisting of Time and Study Environment Management as well as Effort Regulation; and finally (4) Learning with others with the subconstructs help seeking and peer learning (for a more detailed explanation of all those constructs see [14][18]). We included the motivational part of the MSLQ in the pre-survey and the learning strategy part in post-survey. Thus, the SRL perspective informed major parts of measuring learner factors and learning processes in our research design. As the MSLQ is designed for student learners, we adapted a number of questions to the context of corporate training.

Kirkpatrick's Four-Level Model of Training Evaluation [15] was the basis for measuring learning outcomes since, more than the two other frameworks, it emphasizes both short- and long-term effects of learning results. The model suggests four levels of training assessment: participant reaction (the level to which learners are satisfied with the learning event), learning (the extent to which learners achieved the intended learning outcome), behaviour (the extent to which learners apply their new knowledge in the workplace), and results (extent to which the learning results in organizational change).

Finally, we added a number of related factors in the design, which were not explicit part of the frameworks discussed above but nevertheless identified as potentially important by the literature. Apart from demographic characteristics, additional key factors included information about the organizational context of the learners, and the participants technology literacy. For the latter, we adapted the Online Learning Readiness Scale (OLRS) [19]. The further operationalization and an overview of the research design can be found the next section including Fig. 2.

III. METHOD

This research consists of a multiple case study of three short online courses offered to professional from different organizations to identify key factors affecting short- and long-term learning outcomes. We use Biggs 3P model (Fig. 1) as the conceptual framework and operationalize the different factors validated and reliable scales from cognitive and learning science. Figure 2 represents the full-fletched design with the 3P phases, factors and concepts we use.

A. Study setting

This study is set in the context of professional training offered to external organizations by a technical university in western Sweden. The university undertakes a pilot project that seeks out formats to effectively undertake education of professionals with the hindsight of finding a sustainable way to accommodate the individuals' process in lifelong learning.

During the period from November 2018, till April, 2021, the university develops and tests different blended learning formats in form of short online courses within the field of Data Science and AI. The development of course material and format has been based on input from both public and private sector originations represented in a project reference group.

The three courses are all online-based and will use both synchronous and asynchronous online learning activities such as a mixture of; lecture videos, live lectures, online group discussions, literature review and reflective writing assignments as well as online quizzes and peer reviewing to stimulate interaction with both online and written material, peers and faculty. We expect between 20 and 40 participants per course. Each course takes approx. 20 hours to complete.

B. Data collection and operationalization

The empirical data are collected through a mixed method design combining quantitative and qualitative methods:

- A pre-course and post-course survey,

- Two pre-course workshops with representatives from ten reference organizations,

- Learning Analytics collected through the CANVAS learning management system, and

- Qualitative interviews with selected participants and representatives of the participating organizations approx. one (1) month after course completion.

1) Presage

To measure learner characteristics, motivation, technology competence and approaches to learning as part of the *presage* category, a questionnaire will be sent out via email to registered participants prior to the course. The items of this questionnaire are based on adapted versions of Biggs' R-SPQ-2F [17], the motivation part of Pinchers' MSLQ [14] and the OLRS [19] (see Fig. 2.). Together, they cover areas such as Learner demographics, Intrinsic and Extrinsic goal orientation, Self-efficacy and Rationale to participate to mention a few. The questions are answered through agreement to statements in 5 to 7-point Likert scales. An example is:

- *I'm confident I can understand the basic concepts taught in this course.*

Further, information about the organizational context, e.g. company expectations and motivations to let employees participate in the courses, were collected through two pre-course workshops with representatives from ten reference organizations originating from both the public and private sectors.

2) Learning process

During the training, participants' interactions through the learning platform, Canvas, with the training content will be monitored to track the activity of learners with the different learning activities as a measure of *behavioural engagement*.

Secondly, after the training has been completed, another questionnaire will be sent out to participants. This survey includes an adapted version of the learning strategies part of the MSLQ [14] to measure how learners interacted with the course content. An example question is:

- *I often find myself questioning things I hear or read in this course to decide if I find them convincing.*

3) Learning results

Learner performance can be measured by the course result, which for all courses is *pass* or *fail*. To measure the reaction of participants to the course content as well as their perceived learning, learners are asked five general evaluative questions about the course in the post-course survey, including:

- *This course enhanced my knowledge of the subject matter.*

We also ask learners to rate their level of satisfaction with the different learning activities as well as to what extent they contributed to their learning using on a 5-point Likert scale.

Further, we include 11 questions regarding the participants Transfer Implementation Intentions (TII) [20] as a measure of the behaviour level of Kirkpatrick's evaluation model [15]. This includes items like:

- *I will look for opportunities to use the skills that I have learned.*
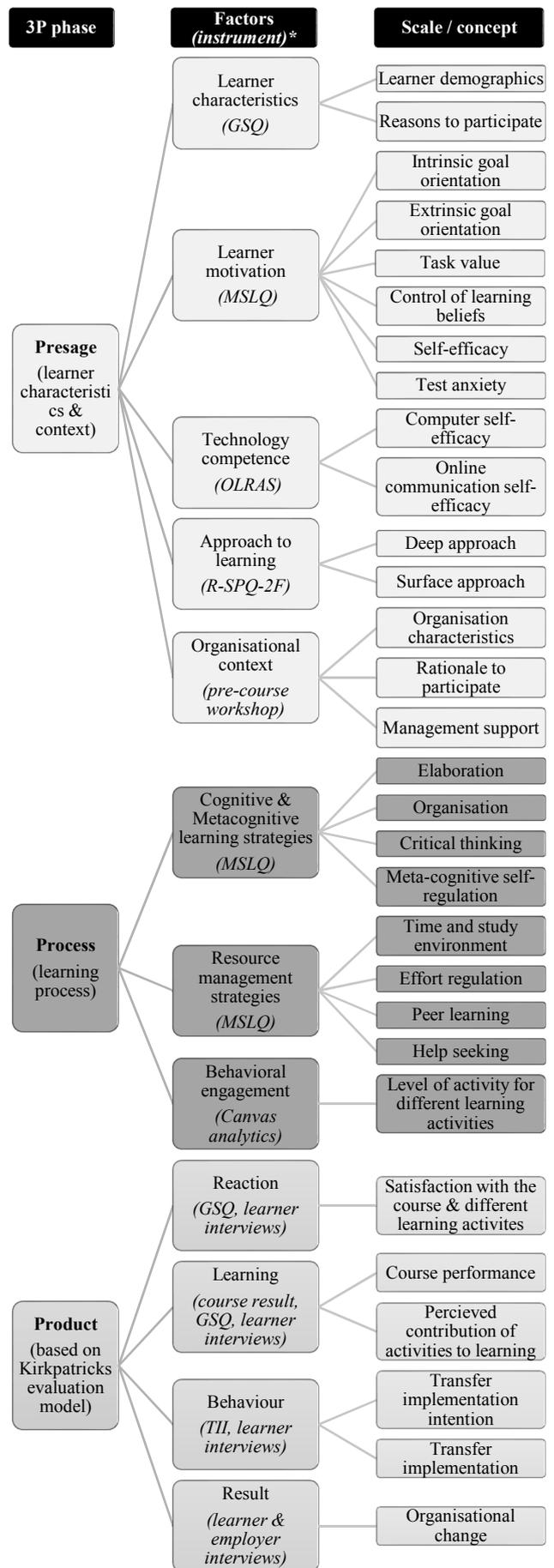
* for an explanation of the instruments see section II & III, GSQ stands for Generic Survey Questions

Fig. 2. Adapted 3P model and factor operationalization

In a time period of two to four weeks after a completed course, approx. three participants per course will be selected for an interview. The selection will be made by convenience based on the willingness of survey participants to participate in an interview and a saturated representation of participating organisations and perceptions of the course. The purpose is to better understand and explain the results of the quantitative data, identify factors enhancing or hindering professionals' ability to take on lifelong learning through education and explore how new knowledge is put into practice (or not). The semi-structured interviews follow an interview guide of open-ended questions mirroring the general themes represented in the conceptual framework and the questionnaires. All interviews will be carried out via booked meetings online. An example of an interview question is:

- *What type of support has your organisation provided in order to help you attend the course?*

Interviews are also planned to be undertaken with a representative of each participating organisation about three to six months after course completion in order to investigate to what extent the course resulted in organisational change. These interviews will be semi-structured and build on results of the participant interviews and their perceived ability to implement knowledge in the home organisation. An example of an interview question is:

- *Can you describe, in general, how change come about in your organisation?*

C. Data analysis

1) Quantitative analysis

The questionnaires will not be anonymous, and participants are made aware that by filling out the questionnaire they agree to be part of the study. Thus, we can cross-correlate the different individual factors (e.g. motivational traits) with the course performance, course satisfaction and participation in the different activities as well as the level of activity with course performance.

We mainly use established scales for measuring the different factors, that were operationalized through 3-8 items per factor and calculate the factors following the guidelines offered by the different measurement instruments (Fig. 2).

The relationships will be evaluated applying Pearson product-moment correlation, whereas a correlation is significant if the p-value is 0.05 or below. The correlation coefficient can be interpreted as representing an effect size of the strength of the relationship between two variables. A correlation coefficient of .10 represents a small correlation, a coefficient of .30 a moderate correlation, and a coefficient of .5 or above a strong correlation [21]. To account for co-variates, we will also develop and test a multi-variable regression model to identify key factors that impact the participants learning.

Further, we will compare groups of participants based on variables such as organisational motivation, transfer of knowledge to the job and organisational change that are based on the categorisation of qualitative data of the pre-workshops and interviews using ANOVA in search for statistically significant differences between groups.

2) Qualitative analysis

The interviews will be recorded, and later summarized. An explorative content analysis of the interview summaries will be done by the researchers separately to gather their own list of quotes, phrases and key words pertaining to Reaction, Learning, Behaviour and Results (see Fig. 2). The summary of an interview will also demonstrate the individuals learning path from presage through context to the effect on the product (See Fig. 1). The authors will later compare and discuss their findings in order to identify unexplored factors in the quantitative data. This procedure will prevent a strong bias in the interpretation of data. The joint discussion of the analysis of the qualitative data will also aid in the interpretation of the relations identified through the quantitative analysis.

IV. EXPECTED RESULTS

The study examines current practices of blended online learning in the context of corporate training and how the format fits with industry's' need for education and training for lifelong learning. Preliminary results suggest a broad variation in participants' educational background and degree through all courses. Intrinsic motivational aspects are the primary reasons to participate, while career advancement or company policies appear less important. Asynchronous learning activities appear somewhat more appreciated due to the increased flexibility in terms of when to engage with them. Participants also show a broad variation in their chosen learning strategies, though a clear focus is put on individual rather than peer learning. Learning practices and strategies seem to change from those of a student in their early 20's to a more practice-orientated approach as a trainer/participant at later stages in life. These implications on pedagogy for lifelong learning through education, concerning the learning process, will be interesting to follow up on.

The final results will further increase our understanding of how, or why, for whom, and under what circumstances online blended training pedagogy work (or not), to stimulate lifelong learning and putting knowledge into practice. We will become more aware of the effects of individual and context factors on the participants learning experiences and organizational change. Given the diversity of learners in this professional development context, we expect those factors to have a decisive impact. This is important since while online learning has been demonstrated to be able to serve different learner groups [22], it also tends to put higher demands on SRL skills [23].

Our findings will help organisations, instructors, learning designers and other practitioners to better adapt online learning events to the target learner group, including needs for scaffolding and support. They will also contribute to the ongoing discussion on changing notions of lifelong learning versus lifelong education [24][25].

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