

Narrowing Down Learning Research: Technical Documentation in Information Systems Research

Convergence of research areas for customer learning of technical product functionalities

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Abstract—learning how to use technical products is of high interest for customers as well as businesses. Besides product usability, technical documentation in various forms plays a major role for the acceptance of innovative products. Software applications partly integrate personalized learning strategies but late developments in information and communication technology extend these potentials to the non-software sector too. Mobile devices as smartphones allow the linking between physical and virtual world and are thereby eligible instruments for product learning and the application of adequate learning theories. Very few scientific publications accurately addressing the learning of product features and functionalities can be depicted. By applying a research profiling approach as a stepwise analysis of available publications, relevant learning paradigms and their corresponding scientific areas are depicted. As this research topic relates to marketing as well as information systems research the applied approach may also show beneficial for other interdisciplinary intentions.

Keywords—*problem-based learning; self-regulated learning; self-directed learning; product learning; customer learning; consumer learning*

I. INTRODUCTION

It is said that the average European owns about 10.000 items [1]. These items are acquired because of personal needs and habits and later become part of daily routines and usages. Businesses compete to gain potential customer attention by applying various advertising strategies and techniques from simple printed and multimedia commercials to different kinds of less consciously strategies like guerilla marketing. Most of these strategies are based on the idea that the potential customer uses communication channels to fulfill communicational needs and therefore the same channel could be used for brand or product placements. Channels where marketing activities are placed have usually no relation to the product itself nor can the advertising message be timed with a potential usage scenario of the advertised product. Marketing activities while a customer is actually using a product, especially within the adoption process, allow the purposeful transportation of marketing messages.

Besides the product itself as carrier of such information, additional product information, manuals or instruction sets act as connector between company and customer. Customers see these as part of the product and therefore include them into

product evaluations and current or future buying decisions [2]. Software products allow the integration of learning techniques

The mutual relation between the product itself and its corresponding additional documents shows especially high importance for technical products and especially for software applications, as these require deeper product knowledge. Studies show that various experts for Internet, communication and media even doubt the disappearance of additional documentation for electronic devices [3]. Usability research focuses on different aspects of product design [4] where technical communication in form of external documentations [5] fulfills the purpose of guiding the user through a product related situation. Redish [6] gives a personal and detailed insight into the relation. While printed versions of product documentation only allow information flow from product producer to customer, recent developments in communication technology and diffusion of required hardware provide more versatile ways of information flow for physical consumer goods too. Technologies like machine-to-machine communications, cyber-physical systems or technologies to bridge virtual and physical worlds as NFC provide manifold ways of information exchange.

Our ongoing research focuses on the transition from classic product documentation and information to the formation of a bidirectional one-to-one communication channel between businesses and customers. This is applied by personalized learning methods with high customer acceptance in the field of learning to use product functionalities. While customers profit due to faster and more convenient learning progresses, businesses gain insights not only into their products but also into customer requirements. This opens opportunities to analyze real usage scenarios and determine what functionalities are utilized and how customers apply them. Additionally, issues and mistakes users are recurrently facing while usage are spotted.

Thereby businesses are given opportunity to adjust products and services for improved customer experience and higher user satisfaction [7]. Businesses applying such methods are able to gain competitive advantages and open new potentials for various marketing purposes. This area of tension between product marketing and digitally enabled product learning demands an alternative angle of view on learning theories with high relevance for information systems research. E-learning is

a contiguous discipline and field of research but focuses primarily on teaching aspects between teacher and student and thus does not cover aspects of marketing or product adaption.

A. Technical communication in marketing and information systems research

Technical communication includes both internal and external information regarding the product where technical documentation refers to documents and information that is handed specifically to the user [2]. External documentation therefore acts as an instrument of marketing by allowing customers to enhance their product experience due to the application of feasible learning approaches. Literature for learning and learning paradigms in technical documentation rarely covers impacts for customer satisfaction or buying behavior while marketing and information systems aspects chiefly focus on the design and usability of products and their corresponding documentations. Technology acceptance research as well as usability research define the factor of *easy-to-use* as crucial for positive product adoption [8]. Nielsen [4] and Davis [9] both describe the easiness to learn how to use a product has especially high impact on “easy-to-use”. Products that are easy to learn therefore lead to a competitive advantage, which shows relevance whenever a potential customer enters the product adoption phase. Studies confirm that usage lifecycle for consumer goods decreases for various product groups like cars [10] or mobile phones [11]. Product groups with shorter usage lifecycle are rebought in shorter intervals and undergo these adoption phase more often, which also implies additional learning effort for customers and therefore higher product switching costs.

A bidirectional information flow in learning frees potentials for both businesses and customers. While businesses gain additional insights and knowledge according their product usage and handling customers benefit from the thereby improved product support and faster learning progress. In other words: an application of appropriate learning techniques and systems when using products fosters user experience in adoption as well as usage phases. The change in communication behavior and new technical possibilities allow new ways of knowledge and information transfer, which are addressed in research areas related to e-learning or m-learning. While these topics focus on the aspects of teaching little research is known in the context of learning how to use a product. Also a clear definition of product learning in terms of keywords or research areas is missing and corresponding literature is widely spread. This interdisciplinary research includes topics from the fields of learning, marketing as well as information systems research with an absence of connecting links between them. The here applied approach bridges this gap by providing an opportunity to determine accurate scientific literature due to the identification of the most relevant connecting terms used in publications.

By applying such an approach a broader perspective is ensured and relevant publications in these areas are highlighted. Learning theory literature acts as a foundation as the awareness in human learning theories ensures the application of customer accepted product support.

B. Research methodology

Learning in a scientific context is wide spread and reaches from various learning techniques to modern e-learning topics. In chapter 2 we focus on relevant terms related to learning contexts that take place while learning how to use a product. These theories on learning build the foundation for the following literature analysis as they reflect the concerning paradigms that correspond to users when exposed to product learning situations (**Applied research approach**). Three major terms could be depicted which are then explored by a bibliometric literature analysis to determine their relevance in science and especially in the subject areas of marketing and information systems. Abstracts of the spotted publications in marketing and information systems research were analyzed to extract terms with high relevance for product-related customer learning. This first analysis is limited by the primarily determined learning paradigms, which may omit relevant keywords for further research. To overcome this eventuality a second analysis was conducted. Again a keyword-based literature approach was performed in chapter 3 to verify the relevance of these keywords according to the aspired research project as well as to identify other terms and research areas with high impact that could be excluded in the beginning due to the formerly selected learning-related keywords. Evaluation of results from the first attempt approved the selected terms but also additionally appropriate keywords were found. Finally chapter 4 gives a conclusion of the findings and also depicts limitations of the conducted research.

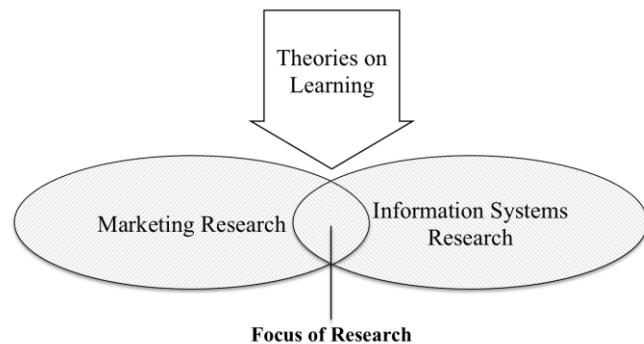


Fig.1. Applied research approach

II. LEARNING PARADIGMS IN RESEARCH

Various research fields such as Social Sciences, Psychology or Computer Sciences are related to learning theories but look at them from different perspectives. This chapter gives an insight into learning theory, which acts as an important foundation for further research in product and consumer learning. Product-related learning sets the focus on the learner and therefore requires adequate methods regarding style and format of learning to support knowledge building [12].

In literature various facets of learning are discussed. The Organization for Economic Co-operation and Development (OECD) defines three different forms of learning: formal, informal and non-formal learning [13-14]. While formal learning relates to an actively controlled process of knowledge transfer informal learning takes place without an intention of knowledge gaining. Learning is defined as non-

formal when a formal learning environment enables learning in an informal way so an additional knowledge gain happens as a positive side-effect. OECD categorizes learning forms by learning awareness. Often mentioned dimensions of learning are self-regulated, self-directed and problem-based learning. These focus on the intention of learning and put personal learning habits into the center of attention. From a marketing perspective the respective intentions to learn how products work gives important insights for product positioning and feature implementation. This is highly related to personal learning habits, as product learning requires personalized actions to support a wide audience of potential customers. Research topics within the fields of self-regulated, self-directed and problem-based learning are expected to be applicable for further product learning research.

A. Self-regulated Learning, Self-directed Learning, Problem-based Learning

Learning situations in context of products are expected to take place when customers are not capable of performing a task to accomplish a goal. This is especially relevant for early product adoption phases where potential customers evaluate products by direct testing [15,16]. The customer identifies the gap between the current product related knowledge and an aspired outcome as a problem to overcome. This learning by doing approach puts customers in realistic usage situations where they encounter typical usage scenarios. Problem-based Learning is also well applied in pedagogic environments. Students get introduced to realistic cases, which enforce them to add additional meanings to the content of learning by applying problem-solving strategies. This matches with the problem situation to overcome when learning to use product features.

According to Loyens, Magda and Rikers [17] two main related fields of interest related to Problem-based Learning are Self-directed Learning and Self-regulated Learning. Self-regulated Learning describes learning as process where learners show active empathy and autonomy regarding their learning style and progress. Self-regulated learners are aware of their strengths and weaknesses and therefore react to these attitudes by individually set actions. Developmental, contextual, and individual boundaries and the self-motivated expansion of personal knowledge are the essential triggers for Self-regulated learners.

Self-directed Learning on the other hand sets a wider focus on proactive learning, which is often described in adult education or as life-long-learning [18]. It originates from the idea that learning does not happen in isolated environments but rather in an open interchange with others. The willingness to extend existing knowledge plays a major role though, as personal autonomy and self-managed learning processes have to take place. Smartphones or tablet computers with permanent connection to the Internet support these learning paradigms as they allow access to requested information independently from location or time.

B. Research Method

All these aspects view learning from different perspectives but characterize situations that have to be considered for gaining a deeper understanding on how product learning takes

place. To examine already existing state-of-the-art literature on product learning and to also determine related research areas a literature analysis was conducted. The research profiling approach as a bibliometric method showed beneficial in similar research situations [19] and allows a widen analysis of existing publications. In contrast to classic literature reviews this approach gives profound insights into the topic by including a vast majority of relevant publications. For our purpose not the total number of publications is of importance as results will be used to determine keywords with highest relevance, rather than as a final source for further research.

The science database ‘Scopus’ as part of the ‘SciVerse’ platform was selected to perform this scientometric literature analysis as access to all publication abstracts was provided which showed beneficial for the second analysis. The research was conducted in February 2013. To give a wide overview of results no limitations but the search terms were set. In a first run the total available search results for the terms *problem-based learning*, *self-regulated learning* and *self-directed learning* within abstracts, keywords and titles of scientific publications were examined. After a first review the search terms were limited to keywords only as these are explicitly defined by the authors and therefore show more accurate results in terms of dealing with learning as key element of research.

C. Results

It can be stated that problem-based learning plays a major role in research in comparison to self-regulated and self-directed learning. While latters showed between 628 and 635 results problem-based learning outnumbers both with almost 85% of total related results in research.

Problem-based learning also shows a strong yearly growth in numbers of publications while only small increase in research related to self-regulated and self-directed learning can be spotted. More important than the number of publication are the subject areas where they got assigned to, as these show the fields of research with strong relevance for learning.

TABLE I. TOTAL AMOUNT OF SEARCH RESULTS ON SCIENCE DATABASE SCOPUS

	Self-regulated learning	Self-directed learning	Problem-based learning
Total results	1.170	1.959	8.338
Keyword results	628	635	6.796
2012	125	84	570
2011	125	102	607
2010	99	94	610
2009	72	78	653
2008	60	67	616
2007	30	47	532
2006	27	39	516
2005	14	25	434
2004	13	21	374
2003	11	18	352
2002	10	8	279

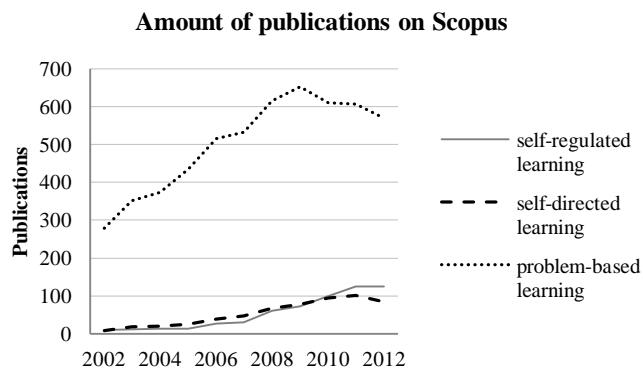


Fig.2. Search result growths on science database Scopus

TABLE II. SUBJECT AREAS OF PUBLICATIONS

Self-regulated learning	Self-directed learning	Problem-based learning
Social Sciences (391)	Social Sciences (294)	Medicine (3.429)
Psychology (222)	Medicine (192)	Social Sciences (2.661)
Computer Science (185)	Computer Science (154)	Nursing (1.582)
Engineering (47)	Engineering (93)	Engineering (618)
Mathematics (32)	Nursing (65)	Computer Science (471)
Arts and Humanities (28)	Psychology (30)	Biochemistry, Genetics and Molecular Biology (311)
Business, Management and Accounting (18)	Business, Management and Accounting (27)	Pharmacology, Toxicology and Pharmaceutics (254)
Medicine (15)	Pharmacology, Toxicology and Pharmaceutics (27)	Health Professions (201)
Nursing (6)	Mathematics (26)	Psychology (188)
Decision Sciences / Economics, Econometrics and Finance / Neuroscience (3)	Biochemistry, Genetics and Molecular Biology / Arts and Humanities (19)	Dentistry (150)

Profiling showed 418 publications as *undefined* subject areas for the search term *problem-based learning*, which were excluded from final results.

D. Discussion

Medical related fields of research such as Medicine in general (3.636 results), Nursing (1.653) or Dentistry (155) show strong interest in learning paradigms. Here the main focus is set on publications on the application of learning in working environments as these professions not only interact with but also attend other persons in a relationship between professional and patient. The second focus can be spotted in Social Science (3.336) and Psychology (440) as these areas relate to the behavior of students and teachers in learning environments.

TABLE III. MOST PUBLISHED RESEARCH AREAS

	Discipline	Self-regulated learning	Self-directed learning	Problem-based learning	Totals
1	Medicine	15	192	3.429	3.636
2	Social Sciences	391	294	2.661	3.346
3	Nursing	6	65	1.582	1.653
4	Computer Science	185	154	471	810
5	Engineering	47	93	618	758
6	Psychology	222	30	188	440
7	Biochemistry, Genetics and Molecular Biology	1	19	311	331
8	Pharmacology, Toxicology and Pharmaceutics	1	27	254	282
9	Health Professions	2	14	201	217
10	Dentistry	0	5	150	155

The gain in publications especially for problem-based learning shows an increasing interest for research in learning environments. While numbers in Social Sciences, Psychology, Engineering and Computer Science reflect psychological and technical aspects of learning, business related areas like marketing did occur far less often. The Scopus subject area *Business, Management and Accounting* lists 128 entries for the given search terms, which seems relatively under-represented, compared to very specific research areas such as Dentistry. Outcomes here should build a base for a deeper study of learning paradigms in general and should allow implications for product related learning strategies as well.

III. PRODUCT RELATED LEARNING IN RESEARCH

To identify the most represented keywords related to the application of learning in context of products or customers first study's search results were examined.

An abstract analysis determined *customer learning*, *consumer learning* as well as *product learning* as relevant terms for the application of learning approaches on product adoption and product support. Based on the outcomes of these results a second research profiling run was undertaken. Results of this second attempt should (1) list publications specifically relevant for product related learning (2) examine other potential keywords for further research and (3) ensure the focus in marketing and information systems for spotted publications to proof the relevance for these research areas.

A. Research Method

Again Scopus as science database was conducted for this second study. No limitations in terms of publication date, scientific field or publication type were given. The three key-phrases *customer learning*, *consumer learning* and *product learning* were concatenated by the *OR* parameter to find all relevant publications containing one or more of these terms in abstracts, titles, keywords and available full text papers as well.

A database-based information system was used to determine the amount of used keywords assigned by authors (author keywords) and the Scopus system (index keywords) [20]. Terms with different spelling in British and American English like *behavio(u)r* and *behavior* were merged to one result and numbers were added up when calculating result hits.

B. Results

Scopus allows the exportation of up to 2000 search results containing all descriptive meta-data except the full text. 1.811 results for the given query were returned which were then exported, manipulated and imported into a database system where each used keyword got stored as one row. All results were transformed to lower cases.

TABLE IV. TOTAL AND DISTINCT KEYWORDS IN SCOPUS

	Author keywords	Index Keywords
Total keywords	5.465	7.503
Distinct keywords	3.648	4.259
Uniqueness of keywords	66,75%	56,76%

Authors assigned 5.465 keywords in total with 3.648 distinct results while the Scopus index system assigned 7.503 in total with 4.259 distinct. The results highlight the dispersed contexts of product-related customer learning with more than 2/3rd unique used author keywords. Researchers entering this research are faced with these divergent results when attempting state-of-the-art research. The application of a scientometric literature analysis like the here conducted shows beneficial for research projects in similar interdisciplinary fields. While researchers attempt to assign their publications to at least one established and therefore strongly used keyword this cannot be stated for scientific publications on learning of product usage.

TABLE V. AUTHOR AND INDEX ASSIGEND KEYWORDS

Author keywords		Index Keywords		Totals	
Hits	Keyword	Hits	Keyword	Hits	Keyword
85	consumer behavio(u)r	63	marketing	99	consumer behavio(u)r
34	learning	63	article	88	marketing
32	advertising	60	learning systems	66	product development
29	brand equity	59	human	63	article
28	innovation	50	product development	62	decision making
27	internet	49	decision making	60	learning systems
25	marketing	38	female	59	human
22	consumer learning	38	mathematical models	58	customer satisfaction
21	customer satisfaction	37	customer satisfaction	56	learning
20	pricing	36	information systems	55	innovation
17	dynamic pricing	36	electronic commerce	53	electronic commerce
17	electronic commerce	35	adult	49	internet
17	brands	34	sales	45	advertising
17	new product development	33	male	38	sales

16	product development	31	neural networks	38	female
15	virtual worlds	29	costs	38	mathematical models
15	materialism	27	innovation	36	information systems
14	customer relationship management	26	adolescent	35	adult
14	e-commerce	26	project management	35	neural networks
14	knowledge management	25	product design	34	brand equity

Consumer behavio(u)r with a total of 85 hits is by far the most assigned keyword by authors with more generic keywords as *learning* (34) and *advertising* (32) following. Keywords seem to be dispensed as only these three have 30 hits or more. Index keywords on the other hand show higher repetition with 15 distinct keywords above 30 hits where 7 show more specific relation (learning systems, product development, decision making, customer satisfaction, information systems, electronic commerce, neural networks) to the field of research. In a last step all hits were again organized in one single list to show the total number of hits regardless if assigned by authors or Scopus.

C. Discussion

Results show essential for further research regarding product-related customer learning. It can clearly be stated that the topic is of high importance for the field of marketing. Beside the term *marketing* itself (88 hits), *consumer behavio(u)r* (99), *customer satisfaction* (58), *advertising* (45), *sales* (38) and *brand equity* (34) can be designated to the field of marketing. On the other hand also terms within the scientific discipline of information systems emerge such as *learning systems* (60), *internet* (49) and *information systems* (36) itself. Third, keywords are highly represented with a connection to marketing as well as information systems. Terms like *decision making* (62), *innovation* (55) or *electronic commerce* (53) belong to this third group, which also emphasizes the strong relation between both research areas in terms of product-related customer learning.

TABLE VI. MOST RELEVANT SEARCH TERMS AND CORRESPONDING RESEARCH AREAS

Marketing	Information Systems	Marketing / Information Systems
consumer behavio(u)r (99)	learning systems (60)	<i>decision making</i> (62)
marketing (88)	Internet (49)	innovation (55)
customer satisfaction (58)	information systems (36)	electronic commerce (53)
advertising (45)	-	-
sales (38)	-	-
brand equity (34)	-	-

By performing a content analysis for each single keyword an additional evaluation was processed. Except *decision making* where a strong focus on medical science areas can be spotted all determined keywords show high importance for the areas of information systems and marketing. While result of the first conducted research listed relevant areas of science this

second attempt widened the spectrum by determining the relevant terms within these research areas. Both approaches start with different premises and so mutually complete the final results. The field of marketing, and especially consumer behavior and consumer satisfaction, shows high impact on learning of product functionalities and is thus of prior interest for further research.

IV. CONCLUSION AND LIMITATIONS

Results point out that learning in context of product knowledge lists publications that mainly focus on the research fields of marketing and information systems. Of course the here-applied methodology approves less explorative for fields with clear assigned research. For wide spread areas such as product-related customer learning or other multidisciplinary fields this keyword-based approach shows the main involved scientific disciplines and the most relevant keywords for further research and is therefore beneficial in early research stages. This narrowing down of a very diverse field of research was conducted by a stepwise literature analysis. The first analysis represents the origins of research where a focus for a topic was set by the determination of relevant keywords for a bibliometric analysis. This analysis sets the base for the selection of relevant publications to determine required background knowledge before entering a research discipline. A second literature analysis based on keywords out of literature not only shows further meaningful keywords but also ensure the relevance of the selected keywords for specific research areas. Besides the three determined search terms *customer learning*, *consumer learning* and *product learning* new relevant terms within the disciplines of marketing and information systems could be depicted.

It should be stated that this research approach is also subject to some limitations. Although the popularity and dataset of the Scopus database by SciVerse, no other source in form of publication database was conducted. Even though for the purpose of this study the total amount of publications results is not of major relevance this limitation should be noted. Also the examined keywords were only revised in differences by spelling British and American English. No semantic relation between the terms was performed which therefore lists *customer* and *consumer* as different keywords although their similar meanings. At last also the assignment of keywords to disciplines of science is always nondistinctive as only the publication itself can directly be assigned to disciplines. For the purpose of this study the assignment was only performed to ensure a proper determined focus of research.

V. FURTHER RESEARCH

The results determined in this paper lead to two main fields for further research. First, technical documentation for complex products as an important instrument of marketing has to be understood. Second, learning paradigms and theories are required to create beneficial product support for the customer. A mapping between both areas should demonstrate appropriate learning methods for different customer requirements due to new potentials in information systems. A strong focus hereby,

as current results show, lies on increased customer satisfaction by applying mechanism to shorten learning efforts and building a support base for various forms of problem solving.

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