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Doing research in design: Inquiry of the key competences needed to integrate research in design practice

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Doing Research in Design

Inquiry of the Key Competencies Needed to Integrate Research in Design Practice

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Over the last decades, design research and design practice have become intertwined in a new way, and design study programmes have to react to these changes, providing students with the ability to link their creative practice with scientific research. Design education has to develop solutions for this new demand and support these profound changes of the discipline itself by addressing these issues from the very beginning of design education on the BA level. In order to better understand what the problems are when carrying out research in design, this paper aims to contribute to the topic of the integration of research in design practice by outlining results from a mixed-methods case study conducted at New Design University/Austria. In this study, required main competencies on the part of students in every phase of a holistic design process, which includes research as well as practice, were identified and quantitatively assessed by the students themselves and their teachers, followed by problem-centred interviews with students.

Keywords: design education research; design research; design practice; design process; main competencies.

Introduction

The paper aims to contribute to the topic of the integration of research in design practice. Research and design practice have become entwined in a new way over the last decades, which can be characterised by "'permeability' of various practices within the 'continuum from creative practice to scientific research" (Dunin-Woyseth & Nilsson, 2014, p. 12). As universities strive to enhance the connection between research and teaching, forms of *learning by research* have become popular among university teachers, informing both course and curriculum design. *Learning by research* denotes a broad field of related but differing formats on how to structure students' learning process. In a basic sense, they all imply that students engage in an active way with some elements of a research process, i.e. working on a research question they themselves posed, using scientific methods and concepts and assessing their course of action in a critical manner (Huber, 2013). A concept that is widely used in the creative arts and that may be linked to *learning by research* is *practice-based research*. This approach also is not defined in a uniform way since varying definitions are used in different disciplines. For Candy and Edmonds (2018), the key defining element of *practice-based research* is that results may easily be incorporated into existing and emerging practice. The results of *practice-based research* must further transcend the specific context in which they emerged for the research to be relevant as such. However, the *practice-based research* approach does not cover the aspect of how the design process for design projects that want to meet the scientific requirements should actually look like, as well as which research process or study design should be applied. By reviewing the literature on examples for implementation strategies, it was found that the current academic discussion focuses mainly on PhD programmes (Vaughan, 2019; Vaughan & Morrison, 2014), but little attention is being placed on how to implement a link between research and design practice at lower level studies. To prepare students for further study programmes like a MA or PhD programme, it is essential to establish an awareness and understanding of the necessity of an active knowledge bridge between research and design practice during their BA studies.

Design education has to develop solutions for this new demand and support these profound changes of the discipline itself by addressing these issues from the very beginning of design education, the BA-level. Confirmed by teaching experience at BA-level, where students experience research-related tasks within their design project work as conflicting with their identities as creative individuals, scientific-methodological work is perceived as impacting negatively on the creative process. However, the ability to reflect on one's own creative work seems to be a crucial skill for design students to productively connect analytical-methodological with creative-artistic practices in their design process.
In order to work on a change in academic design education, it is essential first to understand what the problems for students are when carrying out research in design. Taking up this challenge, a case study with students of the sixth semester of the BA-programme *Manual & Material Culture* at the New Design University in Lower Austria, where persons with a degree from secondary school as well as a background in the crafts trades are admitted to study, was conducted. The choice fell on this study programme because of the fact that some of the enrolled students have a professional background in the crafts trades but have no experience with scientific working prior to their studies.
The case study was conducted using a mixed-methods, quantitative and qualitative study approach. For the preparation of the case study, the human-centred design process model (Dittenberger, 2019) used for design teaching which consists of six main competencies of a holistic design process, (1) project planning, (2) design research, (3) project conceptualisation, (4) designing, (5) model building and (6) final project presentation, was used to create a questionnaire for students' self-assessment of their competences in each of the categories. The created questionnaire was used by students as a quantitative self-assessment tool, which was triangulated with a qualitative analysis of student perspectives on using a proposed process guide. The case study pursued the goal of answering the question: "Can the required core competencies within each individual phase of a design process provide information about the problems in building bridges between design research and design practice?"

Preparing the Questionnaire

In order to identify the required main competencies in every phase of a design process, the human-centred design process model (Dittenberger, 2019; see Figure 1), currently employed for design teaching, was used. This process pursues a holistic approach of combining research and practice, builds on Huber's (2013) concept of *learning by research*, and provides a guideline for carrying out *practice-led research* (Candy & Edmonds, 2018) in the creative arts.

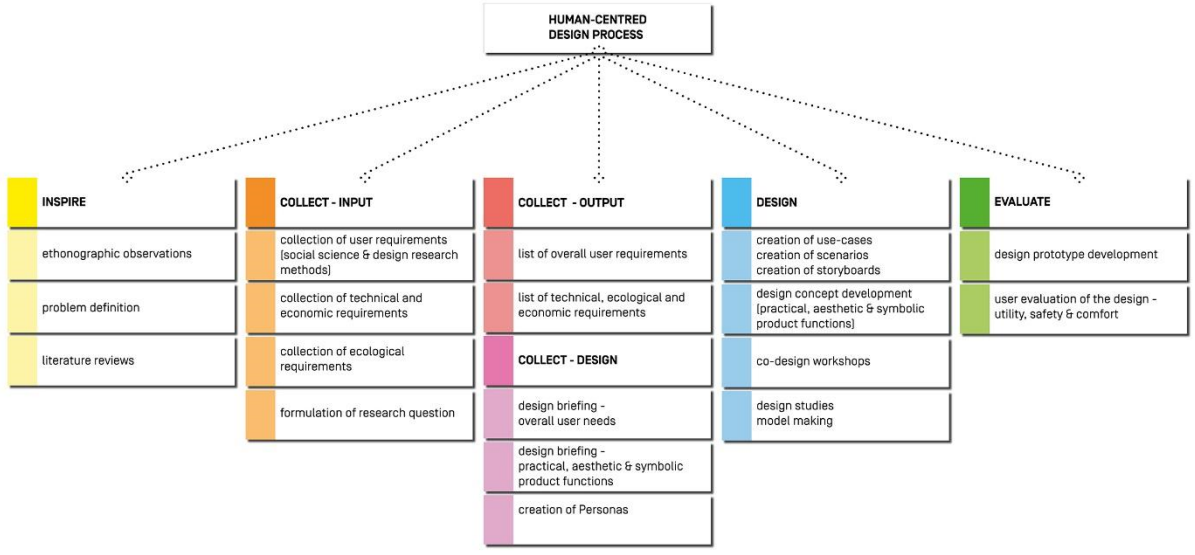

Figure 1. Human-centred design process (Dittenberger, 2019)

This design process is divided into the phases *Inspire*, *Collect*, with the sub-categories *Collect-Input*, *Collect-Output* and *Collect-Design*, *Design* and *Evaluate*.
In the process step *Inspire*, the focus lies on learning about the projects' context. Methods of qualitative social research, such as observational and survey methods, are applied. Based on the results of these studies,

problem areas within the project context can be identified and subsequently comparatively researched in the literature. In order to investigate the identified problem areas in more depth, further methods of qualitative social and design research are used in the *Collect* phase, such as interviews, focus groups or cultural probes. After each method has been carried out, the aim is to focus the project on a specific problem as well as the target group and to collect for this the human, technical, aesthetic, symbolic, ecological and economic requirements. After the broad preparation of the requirements for the selected problem area, the results are evaluated, and a specific aspect is selected. For its processing, a research question and a design briefing for the projects' practical, aesthetic and symbolic functions (Schneider, 2005) is formulated, which should be addressed in the following design phase. Furthermore, archetypal users, Personas, are defined to ensure that the project focuses on the selected target group. The process phase *Design* is dedicated to the development of design approaches, the conduction of design studies and analogue/digital model building. This process step also includes the active involvement and creative incorporation of feedback from the target group in the design development. The phase *Evaluate* represents the final step of the process. Before the final prototype is built, the project gets finally evaluated by people of the target group to see whether the defined design briefing meets the requirements. In an iterative approach, the process is repeated until the evaluation results fulfil the defined requirements.

However, since many students also carry out material studies for their Bachelor theses, work has been done on an extension of this model. Based on the classification according to Candy and Edmonds (2018) that in *practice-based research,* the artefact is the contribution to new knowledge, and in *practice-led research,* it is the newly generated knowledge about practice, the working hypothesis was developed to assign the concept of *practice-led research* to the definition of *applied research* as described in the Frascati handbook (OECD, 2015) as well as to *research with and for design* (Brandes, Erlhoff & Schemmann, 2009). This was done because, in contrast to basic research, the central element here is the investigation of the practical translatability of a specific theoretical approach into design practice. Furthermore, the concept of *practice-based research* was assigned to the definition of *experimental development* as described in the Frascati handbook as well as to *research through design* (Mäkelä & Nimkulrat, 2018).

All the process phases described in the human-centred design process model were examined with regard to the main competencies required for carrying out design research studies as well as for designing and prototype construction. Based on this, a questionnaire was developed that could be used by students to self-assess competencies needed for *practice-led* as well as *practice-based research*.

The main focus rested on finding out struggles in combining design research-related tasks with design practice. To this end, the study was building upon the concept of competencies developed in education and psychology (Schaper, 2012). Fink (2010) explains that there are only a few models for evaluating teaching in a competency-based way. The existing ones either fall into the category of performance tests or self-assessment tools for students on a very general level, not taking into account discipline-specific competence development (Braun et al., 2008; Paechter et al., 2007). Gelmez (2017) made an attempt to adapt these levels to design education but found that this approach still requires further research to develop models for measuring discipline-specific competencies. Thus, the existing approaches could not be used for the aim set out by this study.

Moreover, there was no adequate existing taxonomy of competencies in design that served the need of denoting all main competencies needed for conducting a successful *practice-led* or *practice-based research* process, the competencies had first to be deducted and defined. As a result, based on the human-centred design process, competencies in the six areas were derived in the realm of planning a project, doing design research, conceptualising a project, designing, model building and presenting the project (see Figure 2) and a questionnaire translating the competencies for student self-assessment was created.

The questions within the *project planning* category, which corresponds to the *Inspire* process phase, encompass both competencies in the self-organisation and time management of the design project, the ability to define a topic and a question to be examined therein, and the definition of the objective of the design project. Within the category of *design research*, which corresponds to the process phase *Collect-Input*, questions were raised about the ability to develop a study plan, the knowledge, selection, implementation and analysis of different research methods, the ability to carry out a comparative analysis of design work and to carry out literature research and analysis on the topic as well as the ability to adequately document the design research carried out. At the end of the questions in this category, five known methods of design research were asked to be mentioned freely. In accordance with the process phase *Collect-Output*, questions about the ability to point out problem areas within the independently selected topic area and to develop tasks were formulated in the category *conception*. Based on this, questions regarding the ability of the project's initially formulated questions to be refined based on the knowledge gained and the addressees of the design project were drawn

up. According to the process phase *Collect-Design*, further questions were asked within this category to enable a design brief to be created with regard to the technical-practical, aesthetic and symbolic design function. Subsequently, after assessing the ability to develop a concept, maintaining the project focus during the work process, the flexibility required to adapt goals in the course of the project based on the knowledge gained and to carry out material research and development.

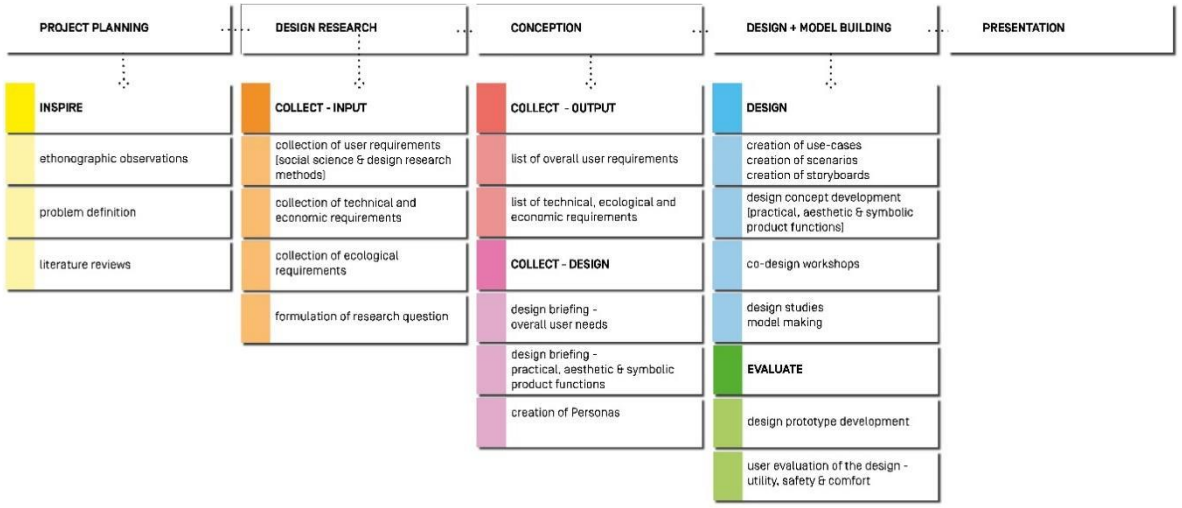

Figure 2. Category chart of key-competencies in a design process

Corresponding to the process phase *Design*, the category *design* asked about the ability in sketching techniques, craft-based and digital model construction, the integration of the addressees of the project into their own design process and the ability to make a connection between design research and their artistic design process. At the end of the questions in this category, five design methods were also asked to be mentioned freely. For the *model building* category, questions were formulated regarding the own discourse ability of their design, the ability of interdisciplinary cooperation, technical construction planning for the prototype building and the skills in crafts-based and digital prototype construction. The process phase *Evaluate* was also assigned to the category implementation and addressed by questions about the ability of the integration and the incorporation of feedback from the addressees of the design project into the design phase. As a final point of the questions about the key competencies, the category *presentation* asked about the ability to use one's own sketching technique, the mastery of 2D and 3D programs and the staging of the project for presentation purposes. In addition, an assessment of the skills of verbal and written project presentation was inserted.

Methodology of the Case Study

After the preparation of the questionnaire, students in their sixth semester received, building on the basics already practised in the previous semesters, specific theoretical input about the design process methodology and design research methods they could use to support their work in the first unit of the semester. Aside from a script denoting the process methodology, they were also afforded a presentation that included works from the past semesters, showing how students had integrated research and practice in different types of design projects. During this presentation, students were informed about the two types of research they could choose from, *practice-led research/research with and for design* or *practice-based research/research through design*, and how these types of research fit with the different types of design projects: *applied research* and *experimental development*. Further, students received a process documentation InDesign template which they were to fill so that by the end of the semester, they would not only present a final practical project but have written documentation (including literature reviews, research findings, design process, photos etc.) of their project, which was to be graded as well.

Case Study Participants

The study was carried out with students from the sixth semester because this final semester is an indicator of the extent to which the concept devised in the curriculum of the interrelating content of previous semesters

reached the students. Since the BA programme *Manual & Material Culture* is a very young design study programme that addresses contemporary issues in design and production, specific self-evaluation is essential for the development of the programme.
Students were selected for interviews by the teachers on the basis of the type of final project they were working on, in order to include students with a more straightforward product design project as well as students who were doing material research and experimental development projects.

Ethics

For the quantitative part of the study, the questionnaires, all students of the sixth semester were involved and asked to fill in anonymously the provided forms. The evaluation of the questionnaire forms was conducted by an external social scientist. Concerning the qualitative part of the study, it was important that all students committed to the interviews on a voluntary basis and were happy to talk about their experiences. In order to ensure confidentiality and to protect students, who would be graded by the teachers at the end of the semester, the interview files rested solely with an external social scientist who conducted the interviews. Results from the interviews were only communicated to teachers after students had received their final grades for the study program. Further, interview results were anonymised by the social scientist, guaranteeing that no personal data was revealed through the communication of the study results.

Covid-19 Pandemic

The specific situation of the Covid-19 pandemic that conspired over the course of the semester in which the study was run led to several challenges. While theoretical inputs could be provided digitally and the interviews could be conducted and recorded via the software Zoom without any major problems, the students were during lockdowns limited in terms of the practical implementation of their projects due to the temporary closure of the workshop premises of the university. However, this problem was successfully addressed by extending the semester from the end of June to the end of September 2020.

Case Study Conduction

In a first trial of the devised tool, students were asked to fill out the questionnaire at the beginning of summer semester 2020 and at the end in order to assess how they viewed their competence development over the course of the semester. During the semester, students received tutorials, after which they were asked to evaluate the gain of skills in each described evaluation category. Since self-assessment only goes so far in depicting competence development, the devised questionnaire was supplemented by an external assessment of student competencies that rested on the same delineation of competencies used for creating the self-assessment tool. A second questionnaire was developed, which teachers had to use to determine the degree to which each student possessed the competencies in question at the end of the semester. This external assessment was then compared with student self-assessment. Following a mixed-methods approach, teachers were also asked to continuously document difficulties students experience in the last semester while working on their final design project, relating to competencies that might be lacking in order to conduct a successful *practice-led* or *practice-based research* process – in a qualitative way. These results were then triangulated with the quantitative analysis of the questionnaires. Lastly, six problem-centred interviews with students were conducted at the end of the semester, aiming to deduct how students view competence development as well as experienced teaching and teaching materials in their final semester.

Results of the Case Study

The following sub-chapters provide information about the results of the quantitative and qualitative methods of the conducted mixed-methods study.

Quantitative Assessment of Design Students' Main Competencies: Questionnaire

The questionnaires for students and teachers were structured in six categories, project planning, design research, project conceptualisation, designing, model building, presentation, and comprised a total of 49 seven-point Likert scale questions as well as two open questions. In order to analyse the self-assessment data of the students at the beginning and end of the sixth semester, all scores given by every single student under each main competence area were summed up, and the respective medians were computed to assess central trends of the distributions. As the medians relate to values lying at the midpoint of the frequency distributions of observed values, they show central trends of the number distributions.

Table 1. Overview of questions per category

	Project planning	Design research	Project conceptualisation	Designing	Model building	Presentation
Formalised questions	6	12	10	5	9	7
Open questions		1		1		
Maximum value possible	42	84	70	35	63	49

Comparing student self-assessment and assessment by teachers, the differences in scoring were analysed. Because the scales at hand are ordinal, and in order to assume as little as possible about the underlying distributions, we employed a non-parametric test (Verma & Abdel-Salam, 2019). Given that there are three groups of assessments (self-assessment by students, external assessment by two teachers), a one-way ANOVA on ranks was chosen, i.e. the Kruskal-Wallis test (Kruskal & Wallis, 2012), with the assumption being that the students score differently than the teachers do. In other words, the null hypothesis is that there is no difference in medians between these three groups of assessments.
In case that the null hypothesis was rejected, pair-wise Mann-Whitney-U-tests (Weaver et al., 2017) were used to find the pair(s) of groups with different medians. Furthermore, the assessments done by the two teachers were compared by using the Wilcoxon signed-rank test (see ibhttps://doi.org/10.21606/drs_lxd2021.). The questionnaires were sent out to 19 students at the beginning and the end of the semester. Two teachers filled out questionnaires assessing each student at the end of the semester.

Table 2. Overview of the completed questionnaires per category

Semester 6	Project planning	Design research	Project conceptualisation	Designing	Model building	Presentation
Beginning	17	17	16	17	17	16
End	19	16	14	13	13	13

Results of the Quantitative Assessment of Design Students' Main Competencies

The following paragraphs provide information on the results of the quantitative assessment.

Results of the quantitative assessment: comparing the assessment of main competencies

Taking a look at how the students self-assessed their competencies in all the main competence categories at the beginning and end of the semester, quite low assessments were found. After normalising the scores, for each main category, about 3.2 points could be reached. The students assess their main competencies in all the categories at only about a third of that. The highest scores can be found for design research and project conceptualisation. These scores are even higher at the beginning of the semester compared to the end.

Project planning

Looking at the medians, we see that the students' assessment of competence levels drops from the beginning (13) to the end (10) of the semester (maximum possible 42), except when asked about their ability to determine a question within their chosen topic. Big differences between the normalised scores at the beginning and end of the semester can be found for the ability to structure and organise (about -1 point) and to develop a timetable (roughly 0.7 points). With the exception of the ability to structure and organise (-1), the medians are stable from beginning to end of the semester.

Design research

Examining the medians reveals a rather low self-assessment of competencies in design research, all medians are lower than half of the maximum points possible. Design research as a competence area has received the highest scores compared to the other main competence categories. However, the median at the beginning of the semester (30) declines until the end (27) (maximum possible 84).

Project conceptualisation

The overall situation is comparable to the other main competence categories. All the medians are well below half of the maximum points possible, and all the medians, again, drop over the course of the semester (23 to17.5, maximum possible 70). Looking at the answers given by the students, the biggest declines in the assessment of competence can be found in carrying out and documenting material research as well as material development. For both, there is an about -0.8-point drop. While for the first statement, the median also drops (-1), the one for the second statement is stable. It might be the case that a few students with a lot of confidence lost a good portion of it while the rest of the group remained at their starting level.

Designing

Overall, the medians are low, compared to the maximum of points that can be acquired (35), and they further decline over the course of the semester (from 9 to 8). The biggest drop is in the students' ability to use 3D programs, -1 point. The second statement that is assessed quite differently at the end of the semester is the one regarding the ability to integrate potential users, where we find a decrease in 1.1 points.

Model building

Within this category, not a single student's statement saw a rise in medians. Whereas the median at the beginning of the semester dropped from 18 to 14 at the end of the semester (maximum possible 63). The biggest differences, about -1 point, between the assessments can be found for the design and implementation of the students' projects using a 3D program as well as their ability to integrate future users of their project into their design process with the help of design research methods.

Drops revolving around -0.5 points can be found for the assessment of the ability to do analogue prototype construction and to create a plan for their prototype. The biggest shift in medians can be found in the ability to construct analogue prototypes (-1) and to integrate future users into the design process (-1).

Presentation

Concerning this category, the medians remain below the halfway point of the maximum points possible (49), alluding to the confidence in competence assessment for presentation skills. The median at the beginning of the semester dropped from 14 to 12 at the end of the semester.

Self-assessment vs external assessment

Our study shows that the teachers tend to give higher scores than the students do themselves. As a result of our statistical analysis, it can be stated that the differences in scoring are not significant. This is to say that although teachers score higher, the more points they give are not spread evenly. When comparing the assessments by the two teachers, we find a significant difference regarding *project planning*. A tendency for divergent assessment can be observed for the main competencies *designing*, *model building* and *presentation*. The explanatory nature of these results is limited by the fact that they rest upon a small sample size. In order to assess whether there was a significant difference between the self-assessment and the external assessment, we employed the Kruskal-Wallis test, comparing the scores given by students at the end of the semester with the assessments given by the two teachers. Despite both teachers giving their students higher scores than the students' self-assessment, we only witnessed one significant difference with respect to two competence categories: designing and presentation.

Qualitative Assessment of Design Students' Main Competencies: Problem-Centred Interviews

In order to supplement the quantitative data assessing competence levels and development in the study program, a qualitative approach was taken to identify student perspectives on working with the suggested process guide, the knowledge bridge between design research and design practice and their view of competence development over the semester. Six problem-centred interviews (Witzel, 2000) were conducted with the students. The results from these interviews were then triangulated with the quantitative analysis of the questionnaires. Due to the specific situation of the Corona pandemic that conspired over the course of the semester, in which the study was run, the interviews were conducted via Zoom and also recorded through this software. The audio files were used for transcription and analysis; the interviews lasted from 35 to 55 minutes. The selected interview passages were transcribed verbatim, which means that it is shown when utterances were cut or dialect was used. Students were selected for interviews by the teachers on the basis of the type of final project they were working on. In order to ensure confidentiality and to protect students (grading), an external social scientist conducted the interviews. Further, the transcripts were analysed through content analysis, and the interview results were anonymised.

Students' perspectives on using the process guide

Students report that the information about the design process and the two types of research they could choose from, *practice-led research/research with and for design* or *practice-based research/research through design*, at the beginning of the final semester was clear and easy to understand. But nevertheless, when they are asked how they perceive the use of the suggested process guide, the answers range from very positive views, students who find its application useful for planning and structuring their design process to students criticising it by explaining that a design process should not lead to standardisation, since designers may go about designing in various ways, i.e. focusing on the technical or using a more artistic approach. It was also suggested to compose different process guides for practice-led research and for practice-based research. In general, students find that it would have been helpful to be confronted with designing as a process a lot earlier in the study program than was being done.

Knowledge bridge between design research and design practice

To all interviewed students, it seems evident that the final practical project has to be accompanied by systematic documentation that embeds the project into design research, theory and history. The reasons given for this need are the following: combining design practice and design research is a skill that graduates of a Bachelor's programme need to master in order to participate in the current discourse on the discipline and to do professional design work; it helps when presenting one's work to potential employers; integrating design research enhances how a designer is able to argue what s/he has created; it strengthens argumentation and as a result how the final object can be presented. Yet, the students explicate that it is challenging to holistically connect design research with their practical projects in their final semester. Some of them find it easier to do so when they are embarking on *practice-based research* (i.e. material studies). Concerning *practice-led research,* they state that the task of bringing together cultural background, reactions from subjects on their designs, design history and a holistic reflection of the design process, which is expected when designing a product, is almost overbearing.

Connecting the Results and Discussion

The results of the mixed-methods study, consisting of a quantitative survey by means of a questionnaire for self-assessment of the core competencies in each phase of a design process and qualitative problem-centred interviews, provide an initial insight into the problem of building bridges between design research and design practice.

It is shown that the cohort studied actually scores their competencies quite low. The students assess their main competencies in all the categories at only about a third of the points that could have been scored. The students rate their competencies lower at the end of the semester than they did at the beginning.

Table 3. Overview of the medians for each competence category

	Median at the beginning of the semester	Median at the end of the semester	Maximum value possible
Project planning	13	10	42
Design research	30	27	84
Project conceptualisation	23	17.5	70
Designing	9	8	35
Model building	18	14	63
presentation	14	12	49

Interestingly, comparing self-assessment with external assessment, we find that the teachers tend to score the competence levels of students higher than do students themselves. Statistically speaking, however, this difference is not significant. We further analysed that the two teachers tend to assess the individual students differently. This difference is significant for the category *project planning*, the tendency can also be observed for *designing*, *model building* and *presentation*. The explanatory nature of these results is limited by the fact that they rest upon a small sample size, though.

The results from the problem-centred interviews with students from the sixth semester, on the other hand, indicate that students do feel confident about their design-related abilities, being able to carry out a final project from the beginning until the end. It is mentioned that students wish to have been taught the applied

design process earlier during the study program, yet all but one feels positive about their skills to carry out all the necessary steps. Obviously, each student denotes specific areas s/he feels better equipped in and others where s/he identifies the potential for further development. Being able to focus their project in the stage of project planning, hand-drawing skills in the stage of designing as well as the ability to connect research with practice are amongst the least developed capacities among the students, in their opinion.
Regarding the suggested process guide, the interviewees differ in their views. While some find it very easily applicable to their work process and stress how it helps them structure, some do not seem to know about its content or criticise that they feel constrained working with it. It is emphasised that the process guides should be introduced earlier during the study program and may also be reduced in size to make them more accessible. The necessity to do design research and to integrate it into their final projects is unchallenged by all interviewees. Some exhibit a quite diffuse notion of what design research is. Yet again, they all wish they would have been confronted with design theory and history more and at earlier stages of their studies. Building a true knowledge bridge between design research and practice in their final projects is seen as a challenging endeavour due to the holistic nature of the design process. Yet an endeavour that is worthwhile when thinking about the quality of the projects, but also for the chances of the graduates to establish themselves in a professional environment as independent designers or employees.

Conclusion

What did we learn from our attempt to understand the difficulties of integrating design research into design practice with the help of an analysis of the main competencies in each phase of a design process? In conclusion, it is stated that an understanding of the necessity of a productive connection between research and practice, which underlies the discipline of design, must be developed at the very beginning of design education from BA-level on and become a self-evident design culture during the course of studies. Furthermore, the conclusion is drawn that the application of structured design processes and their reflection must be taught and practised from the beginning of the course of study on the basis of terminology commonly used by all design teachers. Theory and practice of design processes and a generally valid language on design can thus be internalised by the end of the Bachelor's programme.
The surprisingly poor values in the self-assessment of the students studied suggest that design teaching has to react to this issue. With regard to the complex requirements that designers face after a BA degree, the concept of design teaching has to evolve in order to synthesise the core competencies required in both areas. The conclusion is drawn that the goal of contemporary design teaching on BA-level should be to impart a generalist, methodologically robust but open and solution-oriented approach to linking research and practice, which both addresses the multidimensionality of the demands on the discipline of the design itself and imparts the scientific methodological competence to deal with them productively and self-confidently.
Concerning the feedback from the students on the process guide, the use of the process guidelines has proven to be helpful for explaining the desired bridge between research and practice to students as they mentioned the need for its integration from the very beginning of all study branches within the Bachelor's programme. In addition to these concrete and proven process guidelines, for *practice-led research* or *applied research* and *practice-based research* or *experimental development*, it is necessary to establish an unambiguously communicable, methodologically robust but open process in the sense of experimental research, which can be adapted to the needs of individual design approaches. Concerning the question of how academic research can be conducted within the individual creative practice has been discussed intensively in the past decades in academia. Mäkelä and Nimkulrat (2018) presented the approach of using documentation as a support tool for the reflection process on practical design work. Nonetheless, further research work is necessary in order to draft a holistic process proposal in the field of artistic-scientific research that does justice to the different requirements of the design disciplines and the academic standards.

References

Brandes, U., Erlhoff, M. & Schemmann, N. (2009). *Designtheorie und Designforschung*. Paderborn: Fink.

Braun, E., Gusy, B., Leidner, B. & Hannover, B. (2008). Das Berliner Evaluationsinstrument für selbsteinge-schätzte, studentische Kompetenzen (BEvaKomp). *DIAGNOSTICA*, 54, 1, 30-42.

Candy, L. & Edmonds, E. (2018). Practice-Based Research in the Creative Arts. Foundations and Futures from the Front Line. *Leonardo*, 51,1, 63–69.

Dittenberger, S. (2019). Actively reflective: understanding the drivers and hurdles of building knowledge bridges between theory and practice in design education. In J. Häkkilä, M. Pakanen, E. Luiro, E. Mikkonen & S. Miettinen (Eds.), *Cumulus Conference Proceedings Series 5/2019: Around the Campfire – Resilience*

*and Intelligence (*pp. 414-427), Rovaniemi, Finland: Cumulus, International Association of Universities and Colleges of Art, Design and Media.
Dunin-Woyseth, H. & Nilsson, F. (2014). Design Education, Practice, and Research: on building a field of inquiry. *Studies in Material Thinking*, 11, 3–17. Retrieved from http://publications.lib.chalmers.se/records/fulltext/202140/local_202140.pdf [accessed on 15.March 2019]
Fink, C. (2010). Kompetenzorientierte Lehrevaluation. Diskussion neuer Perspektiven für neue Lehr- und Lernformen. *Lern-Service-Engineering. Multikonferenz Wirtschaftsinformatik, 23.-25.02.2010 (*pp. 433–444), Göttingen, Germany: Georg-August-Universität. , Retrieved from http://webdoc.sub.gwdg.de/univerlag/2010/mkwi/01_management_und_methoden/lern-service-engineering/07_kompetenzorientierte_lehrevaluation.pdf [accessed on 22 April 2019]
Gelmez, K. (2017). Towards a taxonomy of design learning based on students' reflective writings. *REDO Cumulus Design Conference 2017*, *30.05–02.06.2017*. Kolding, Denmark: Design School Kolding.
Huber, L. (2013). Warum Forschendes Lernen nötig und möglich ist. In Huber, L., Hellmer, J. & Schneider, F. (Eds.), *Forschendes Lernen im Studium*. Bielefeld: Universitätsverlag Webler, 9–35.
Kruskal, W. H. & Wallis, W. A. (2012). Use of Ranks in One-Criterion Variance Analysis. *Journal of the American Statistical Association*, 47, 260, 583-621. http://dx.doi.org/10.1080/01621459.1952.10483441
Mäkelä, M. & Nimkulrat, N. (2018). Documentation as a practice-led research tool for reflection on experiential knowledge. *FormAkademisk*, 11, 2, 5, 1-16.
OECD (2015) Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development. The Measurement of Scientific, Technological and Innovation Activities. OECD Publishing: Paris.
Paechter, M., Maier, B., Dorfer, A., Salmhofer, G. & Sindler, A. (2007). Kompetenzen als Qualitätskriterien für universitäre Lehre. In Kluge, A. (Ed.), *Qualitätssicherung und -entwicklung an Hochschulen: Methoden und Ergebnisse*. Lengerich: Pabst Science Publishers, 83–94.
Schaper, N. (2012). Fachgutachten zur Kompetenzorientierung in Studium und Lehre. HRK-Fachgutachten ausgearbeitet für die HRK von Niclas Schaper unter Mitwirkung von Oliver Reis und Johannes Wildt so wie Eva Horvath und Elena Bender, August 2012 [online]. Retrieved from https://www.hrk-nexus.de/fileadmin/redaktion/hrk-nexus/07-Downloads/07-02-Publikationen/fachgutachten_kompetenzorientierung.pdf [accessed on 22 April 2019)
Schneider, B. (2005). *Design: eine Einführung*. Basel: Birkhäuser.
Vaughan, L. (2019). Introducing Practiced-based Design Research. In L. Vaughan (Ed), *Practice-based Design Research*. London, New York, Oxford, New Delhi, Sydney: Bloomsbury, 1–6.
Vaughan, L. & Morrison, A. (2014). Unpacking models, approaches and materialisations of the design PhD. *Studies in Material Thinking*, 11, 3–19. Retrieved from https://www.materialthinking.org/sites/default/files/papers/SMT_Vol%2011_Paper%2002_Vaughan.pdf [accessed on 24 January 2020]
Verma, J. P. & Abdel-Salam, D. (2019). *Testing Statistical Assumptions in Research*. Hoboken: John Wiley & Sons Inc.
Weaver, K. F., Morales, V., Dunn, S. L., Godde, K. & Weaver, P. F. (2017). *An Introduction to Statistical Analysis in Research: With Applications in the Biological and Life Sciences*. Hoboken: John Wiley & Sons Inc.
Witzel, A. (2000). Das problemzentrierte Interview. *Forum Qualitative Sozialforschung*, 1, 1, 22. Retrieved from https://www.qualitative-research.net/index.php/fqs/article/view/1132/2520 [accessed on 15 October 2020]

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