

Evidence-Based Design in Architectural Education: Designing the First Maggie's Centre in Israel

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Abstract

Objective: The study examines the integration of the Evidence-based Design (EBD) approach in healthcare architecture education in the context of an academic design studio. **Background:** Previous research addressed the gap between scientific research and architectural practice and the lack of research on the use of the EBD approach in architectural education. **Methods:** The research examines an undergraduate architectural studio to design a Maggie's Centre for cancer care in Israel and evaluates the impact of the EBD approach on the design process and design outcomes. The research investigates the impact of the integration of three predesign tasks: (1) literature review of healing architecture research, (2) analysis and comparison of existing Maggie's Centres, and (3) analysis of the context of the design project. **Results:** The literature review of scientific research supported the conceptual design and development of the projects. The analysis of existing Maggie's centers, which demonstrated the interpretation of the evidence by different architects, developed the students' ability to evaluate EBD in practice critically, and the study of the projects' local context led the students to define the relevance of the evidence to support their vision for the project. **Conclusions:** The research demonstrates the advantages of practicing EBD at an early stage in healthcare architectural education to enhance awareness of the impact of architectural design on the users' health and well-being and the potential to support creativity and innovative design. More studies in design studios are needed to assess the full impact of integrating EBD in architectural education.

Keywords

Evidence-based Design, architecture education, Maggie's Centre, design process, cancer care, healthcare design

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The study examines the integration of an evidence-based design (EBD) approach to healthcare architecture education in the context of an academic design studio at the Faculty of Architecture and Town Planning at the Technion-Israel Institute of Technology. Maggie's Centres for cancer care were chosen as the main topic for the design studio as they represent successful examples of EBD. The diverse designs of Maggie's Centres around the world by high-profile architects demonstrate the ability of architects to interpret evidence and relate it to the local context of architectural projects.

Evidence-based Design (EBD)

The EBD approach, which has become mainstream in healthcare architecture in recent years, recognizes the impact of the built environment on the performance of the healthcare facility and the well-being of its users. The Center for Health Design in the United States followed the proposal of Kirk Hamilton and defined EBD as "the process of basing decisions about the built environment on credible research to achieve the best possible outcomes" (Center for Health Design, 2009a). The approach was developed following the practice of evidence-based medicine that integrates individual clinical expertise with the best available evidence from systematic research (Sackett et al., 1996). It also relates to a more extensive research field that examines the connection between architectural design and health (Allen & Macomber, 2020; Peters, 2017). While developed primarily for healthcare design, EBD is a universal approach relevant to the design of all building types (Hamilton & Watkins, 2009; C. S. Martin, 2014).

Research into the impact of the healthcare environment on healthcare outcomes has been growing rapidly in recent years. The origin of EBD in healthcare environments goes back to Nightingale's (1863) environmental theory and to the pioneering study of Ulrich (1984) whose work on the effects of a view of nature on patient healing enhanced the development of research in the field of healthcare design and environmental psychology and promoted postoccupancy evaluation of hospitals to assess the performance

characteristics of the design (Joseph & Nanda, 2013). Many scientific studies have collected empirical evidence demonstrating connections between the environmental design of healthcare facilities and outcomes important for patients, families, healthcare staff, and healthcare organizations (Ulrich et al., 2008).

In recent years, EBD has experienced both broad adoption and simultaneous critique for being too ridged and misapplied. Many practitioners feel that EBD is looking backward to confirm, while design practice is looking forward to innovate (Peavey & Vander Wyst, 2017). The debate between EBD and practice-based design questions whether the process of EBD limits the creativity and intuition of architects. Conceptually, EBD advocates a balanced integration of the skills and experience of the design practitioner, the client's needs, and critically assessed evidence of various types. These include evidence grounded in rigorous scientific methodology as well as a continuum of levels of evidence including personal experience and intuition (Brandt et al., 2010). In addition to comprehending and applying knowledge from scientific publications, an EBD process should exploit all available information and critically analyze findings from different sources. A combination of strong, objective research studies and reliable, context-specific data provides architects with a solid foundation for making design decisions (Harris et al., 2008; Figure 1).

EBD in Architecture Education

EBD introduces the necessity of a new skill set to the design practitioner. Although different forms of evidence have long been used to inform building codes, standards, and design guidelines, the utilization of academic knowledge and research-based evidence in professional design practice is still limited and inconsistent (Haq & Pati, 2010; Tvedebrink & Jelić, 2020). Architecture students are typically not taught how to conduct research or use peer-reviewed literature for their projects. Even if students are taught about EBD, there can be an "application gap" between research classes and design studio (project-oriented) classes (Wiley, 2017). Architectural

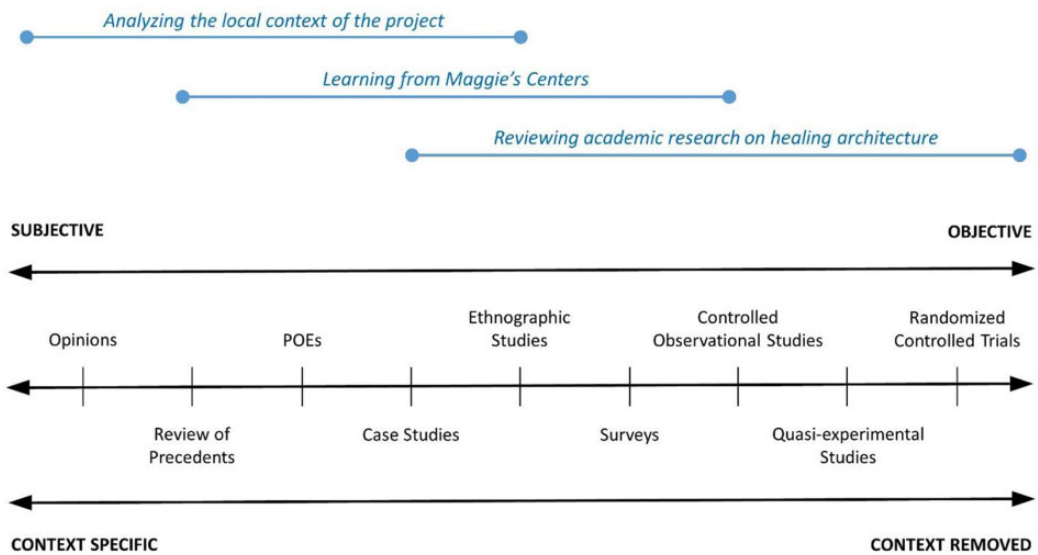


Figure 1. Types of research studies that provide evidence for design decision making (adapted from Harris et al., 2008) with the spectrum of the predesign tasks in the architectural design studio (in blue).

design studios typically focus on an analysis of precedents to provide spatial ideas and solutions, while the supporting theory is often absent (Wiley, 2017). Students are usually compelled to dive directly into the site characteristics and the design-solving process without fully exploring the research-based and analytical ways to reflect on the future user context (Tvedebrink & Jelić, 2020). Although many academics and professionals are calling for increased research and educational reform, stating that research education is essential to moving the architectural profession forward, there is little formal research on EBD education, especially in nonhealthcare areas (Brandt et al., 2010; Viets, 2009; Wiley, 2017). This issue is especially relevant in the post-COVID era, where there is growing recognition of the impact of the built environment on the health and well-being of the population in all building types as well as urgent need to develop new methods for remote architecture education and practice.

Research Methods

The aim of this study, therefore, is to address the need to overcome the gap between scientific research and architectural practice from an

educational point of view and to react to the lack of research on EBD in architectural education. Accordingly, the study examines the implementation of the EBD approach in healthcare architecture education in the context of an academic undergraduate design studio at the Faculty of Architecture and Town Planning at the Technion-Israel Institute of Technology set out to design a new Maggie's Centre in Israel. The study examines the integration of the EBD approach within traditional design studio methods and evaluates the impact of the approach on the design process and design outcomes. To test the EBD approach—basing design on different types of research studies, the studio included three predesign tasks to support the design (Figure 1): (1) a literature review of academic articles on healing architecture, (2) an analysis and comparison of existing Maggie's Centres, and (3) an analysis of the context of the design project in Israel. The design project was developed in three sequential stages: (4) conceptual design, (5) master planning, and (6) designing the new Maggie's Centre. The study investigates the impact of the predesign tasks (1–3) on the design tasks (4–6) and analyzes the different types of research studies' impact on the students' progress. The evaluation is based on observations by the leading researcher,

the advisor of the design studio (Grobman & Neuman, 2007; Hassanain et al., 2012; Saifudin Mutaqi, 2018), a review of the final projects by experts, interviews with the students during the course and after the final presentation, and a survey of the students' reflection on the course 6 months after its completion.

Course Structure and Contents

The design studio was developed by the first author to introduce EBD methodology in architectural education at the Faculty of Architecture and Town Planning at the Technion-Israel Institute of Technology during the spring semester of 2019. The design studio, an academic one-semester course for undergraduate architecture students in the 2nd year of the Technion-accredited professional architecture degree program, aimed to provide the students with knowledge and experience in EBD of healthcare architecture. Inspired by Maggie's Centres' innovative model for cancer care and diverse EBD projects around the world, students faced the challenge of designing the first Maggie's Centre in Israel. The project was conducted in collaboration with Clalit Health Services and Kaplan Medical Center in the city of Rehovot in Israel to expose the students to the challenges and opportunities of the Israeli health system and to provide a realistic context for the academic project. The course of twenty-four meetings of 5 hr included lectures, site visits, meetings with healthcare leaders, group discussions, personal instruction, and a public exhibition at the end of the semester to present the students' final projects. Twelve students chose the course as an elective, many because of their personal experience with cancer in their family.

In response to the research-to-practice gap, the design studio applied EBD in combination with typical design studio methods. The overall design studio was divided into two parts of *pre-design tasks* to gather evidence and a *design project* to implement the evidence. Although the work was divided into two phases, the students were asked to continually search for more evidence to support their design decisions throughout the design process. The course followed the

recommendation of the Center for Health Design for EBD implementation. In the pre-design phase, the students were asked to develop the project vision to articulate the intentions, directions, goals, and objectives for the project based on a critical analysis of evidence. In the design phase, they were asked to develop their design proposal by referring back to the evidence collected during pre-design to create a chain of logic that connects the research findings and their interpretation to related design concepts (Center for Health Design, 2009b).

Inspired by Maggie's Centres' innovative model for cancer care and diverse EBD projects around the world, students faced the challenge of designing the first Maggie's Centre in Israel.

Designing a Maggie's Centre

Maggie's Centres were designed to pioneer a new concept of cancer care to complement hospital medical treatment. The centers provide practical, emotional, and social support to people with cancer, their family, and friends. Initially built on the grounds of specialist cancer hospitals in the UK, the centers have become an international model for holistic and social healthcare designed to create a bridge between hospitals and community care (Maggie's Cancer Centres, 2015a). Maggie's Centres have developed from the first building opened in Edinburgh in 1996 to over 30 sites, found primarily across the UK, but also in Hong Kong, Japan, and Spain. The charity is independent of state healthcare systems, and the services Maggie's Centres provide are complementary to those offered in the adjacent hospitals (Butterfield & Martin, 2016).

Maggie's Centres are unique physical environments. Each building was intentionally designed by a different high-profile international architect, including Norman Foster, Richard Rogers, Frank Gehry, Zaha Hadid, Steven Holl, Rem Koolhaas, and many more, as examples of best practice in architecture. Each of the architects made their own interpretation of the center's program and developed a unique architectural concept and

image. Charles Jencks, an architectural historian and husband of Maggie, described in his book *The Architecture of Hope*: “All the centres are built with certain fundamental themes in mind and an appreciation of how the environment can affect well-being” (Jencks & Heathcote, 2010).

Maggie’s evidence-based program and architectural and landscape brief (Maggie’s Cancer Centres, 2015a, 2015b) offer a set of prompts for the architect to consider how their building will evoke emotional responses in its users (Annemans et al., 2012; Jencks, 2017; Van der Linden et al., 2016). Accordingly, Maggie’s Centres are described as emotionally charged buildings that shape the ways care is staged, practiced, and experienced in everyday life through the orchestration of architectural atmospheres (Duff, 2016; D. Martin et al., 2019). The brief includes some spatial aspects frequently mentioned in EBD studies such as the presence of light and green. As such, the study of Maggie’s Centres forms an important illustration of the relevance of how research about spatial qualities adds to the wholesome character of the built environment (Annemans et al., 2012).

While all Maggie’s Centres were designed for the same architectural brief and are primarily based on the same evidence, their significantly different designs illustrate that an EBD process can support architectural creativity and innovation. The designs of Maggie’s Centres demonstrate the ability of architects to interpret evidence and relate it to the local context of architectural projects. Maggie’s Centres also provided the students with an option to develop their critical thinking by analyzing and comparing EBD outcomes.

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Results of the Pre-design Research Tasks

The EBD process was driven by three pre-design research tasks prepared by the students in

pairs. The pre-design tasks included (1) literature review of healing architecture, (2) learning from Maggie’s Centres, and (3) analyzing the local context of the project, including a site analysis and research on cancer care in Israel.

Literature Review of Healing Architecture

The goal of the literature review was to encourage the students to read and discuss academic literature, a method rarely used in educational studio classes, and to contribute to their understanding of how to develop a much stronger research-informed design proposal. The literature review was conducted by a search of online databases, including the Knowledge Repository of the Center for Health Design, with the help of the studio instructor and the faculty online library services. Working in pairs, the students chose to focus on one of six design topics including lighting, noise, exterior view, connection to nature, wayfinding, and art. Each pair of students presented its findings to the class, creating a broader knowledge of the different design topics and their outcomes. The students were asked to read different articles on their topic, select two significant articles to present to the class, explain why they are important to the design project, and analyze the findings according to a unified framework that was used by all the students (Figure 2). The framework illustrated the impact of each one of the six design topics on the health and well-being of the users. To critically interpret their findings, the students also analyzed how the evidence was implemented in the existing Maggie’s Centres. This method was later used intuitively by the students to explain their design in the final project presentation.

Learning From Maggie’s Centres

The second pre-design task consisted of a comparative study of the existing Maggie’s Centres. The task referred to previous work developed at the Norwegian University of Science and Technology on “healthcare architecture research by drawing”

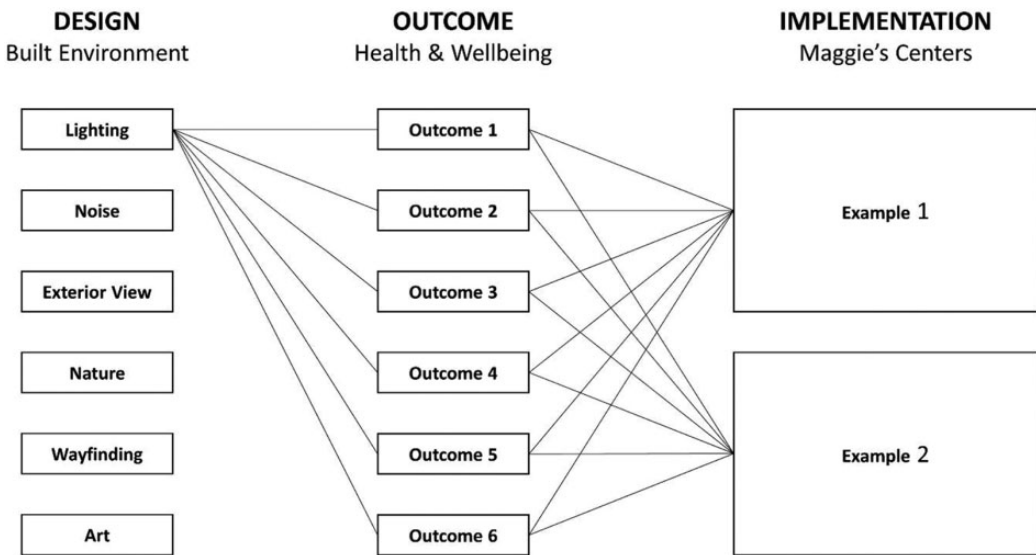


Figure 2. The framework for the analysis of evidence from academic research by design topics and the analysis of the implementation of the evidence in the Maggie's Centers.

(van der Zwart, 2019). The students, working in pairs, were asked to choose two existing Maggie's Centres in coordination with the other students in order to have an analysis of a total of 12 centers and to present their work in PowerPoint and poster format for the final studio exhibition (Figure 3). Each pair of students defined the design topics for analysis and comparison in addition to addressing the location, size, and context of the centers. The students analyzed a variety of design topics including lighting, acoustics, exterior view, connection to nature, wayfinding, and art, the issues that were studied in the literature review, in addition to other design topics including movement in the building, private–public hierarchy, indoor–outdoor relations, materials, and interior design. The task developed the students' ability to critically evaluate architecture design by comparing the intentions to the outcomes. The comparison of the different designs for the same program of Maggie's Centres demonstrated the possibility of interpreting the evidence and implementing it in different ways according to the context of the project and the vision of the architect.

The Local Context of the Project

The design studio aimed to resemble the architectural practice of a real-life project with a specific client and site. Accordingly, the students were asked to analyze the local context of the project, including the site at the Kaplan Medical Center, and the needs of the end users for cancer care in Israel.

Site analysis. Kaplan Medical Center, located in the city of Rehovot in Israel, a 582-bed acute care hospital, developed a master plan with Farrow Partnership Architects from Canada in 2016. The master plan aimed to inspire and raise organizational aspirations in the context of fund capital initiatives that rely on philanthropy (Kaplan Medical Centre–Farrow, n.d.). The students analyzed the master plan in comparison to the existing conditions of the hospital. They addressed the campus layout, typology of buildings, landscape, greenery, soil, wind, surroundings, and different future development plans. The students learned that Kaplan Medical Center currently has 6,000 oncology and 5,000 hematology visits per year, which will significantly increase once they build



Figure 3. Analysis and comparison of existing Maggie's Centers in poster presentation.

the new oncology building as defined in the master planning.

Cancer care in Israel. The students studied the characteristics of cancer care in Israel by collecting demographical and statistical data and by interviewing cancer patients and their family members. The studies identified different needs of patients in correlation to their age and gender and specified the unique psychological, social, and cultural aspects of cancer care in Israel. Many students reflected on their personal experience with cancer care for members of their own family or for friends. This reflection both contributed to, and challenged, the students' work in the design studio.

Results of the Design Project

The main objective of the design project was to creatively interpret the evidence from the pre-design tasks in developing the student individual design concept and detailed solution. The aim was to demonstrate how evidence is applied to each one of the three stages of the design project, including (1) conceptual design, (2) master planning for the new center, and (3) designing the new Maggie's Centre, to gain experience in a comprehensive EBD process.

Conceptual Design

In the conceptual design phase, the students were asked to define the design goals and the methods to fulfill them. To communicate their vision, the students wrote a one-page manifesto and created an abstract 3D model. The combination of the two methods assisted the students to express their ideas and inspiration. All of the students related their conceptual design to the knowledge they acquired in the pre-design tasks and based their concept on evidence from research, the precedents of Maggie's Centres, and the analysis of the project context.

The different conceptual designs addressed the fundamental challenges in designing a Maggie's Centre: How can the design support the mental and physical health of people? How can the design support different users with constantly

changing needs? How can the design create a sense of security, belonging, intimacy, calmness, and hope? Most of the students also addressed the challenge to "translate" the model of Maggie's Centre, developed in the UK, to suit Israel's demographic and social needs. The students asked what is universal and what is local in our conception of a healing environment and how they can design the center to support diverse age and gender users from different cultural, ethnic, and religious backgrounds. The students also confronted critical issues in cancer care in Israel, including the shame that is still associated with the disease, the psychological challenge of becoming dependent on family members, and the need to escape the dense and clinical atmosphere of hospitals in Israel.

The students asked what is universal and what is local in our conception of a healing environment and how they can design the center to support diverse age and gender users from different cultural, ethnic, and religious backgrounds.

Master Planning of the New Centre

The Kaplan Medical Center management recommended locating the new Maggie's Centre at the northeast corner of the hospital campus master plan, but the students were given an option to choose a different location for their project based on their conceptual design (Figure 4). In their decision where to locate the new center, the students reflected on the evidence they collected in the pre-design tasks and on their personal design goals as declared in the conceptual design phase.

The students questioned the relations of the Maggie's Centre with the clinical hospital and with the adjacent isolated residential neighborhood. Some students chose to locate the center at the main entrance of the hospital (Project 1) or at the core of the hospital campus (Projects 2 and 3). In contrast, others chose to locate it in the neighborhood to connect the hospital campus to the surrounding community (Option 12). Some students located the Maggie's Centre in relation to the location and configuration of the planned

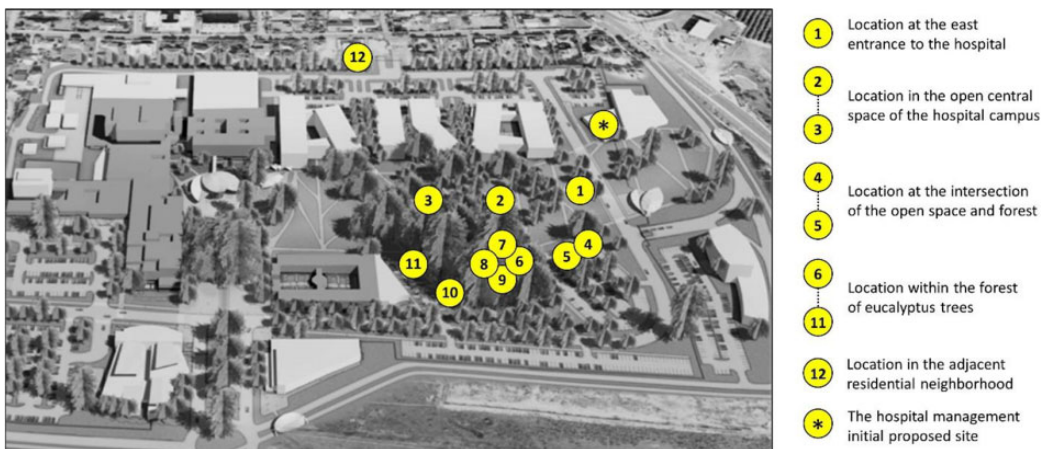


Figure 4. Location of the student's projects on the campus of the Kaplan Medical Center (adapted master plan of Farrow Partnership Architects, 2016).

oncology center (Projects 4 and 5). Others wanted the new center to be distinct from the clinical atmosphere of the hospital and chose to locate it in a forest of eucalyptus trees at the southern area of the hospital campus based on evidence on the impact of nature on healing (Projects 6–11).

Designing the New Maggie's Centre

The variety of the students' designs for the new Maggie's Centre reflected their personal interpretation of the evidence they had collected in the predesign tasks based on their vision for the new center in Israel (Figure 5). The students developed different themes aimed to achieve a sense of community, a sense of control, and a sense of well-being and hope for the patients, family members, and staff. In their designs, the students questioned what is universal and what is local in our conception of cancer care. They explored what they believed should be adapted to the Israeli context to address social openness, social support, lack of private spaces, and diverse cultural, ethnic, and religious backgrounds. Many students suggested that the Israeli center should have a much larger living room and kitchen (Projects 5, 6, and 9), a pool of water instead of a fireplace (Projects 6, 10, and 12), extended outdoor spaces for social activities

(Projects 1, 3, 5, 7, 8, and 10), and hierarchical levels of social and private places (Projects 6, 8, and 12).

The variety of the students' designs for the new Maggie's Centre reflected their personal interpretation of the evidence they had collected in the predesign tasks based on their vision for the new center in Israel.

Based on the evidence they collected in the predesign tasks, the students developed strategies for cancer care. For example, a cancer gallery at the hospital entrance, open to the public, to create awareness and overcome the shame associated with cancer in Israel, was based on evidence on the impact of art on user's well-being (Projects 1 and 2). Some projects were designed to promote health in the hospital campus by creating a dynamic spatial structure that encourages users to move based on evidence on the positive impact of physical activity on health (Projects 2 and 7). Other projects were designed to support the patient's psychological well-being based on evidence on the importance of enhancing a sense of control, by making them responsible for an animal in the pet support cancer center (Project 1)

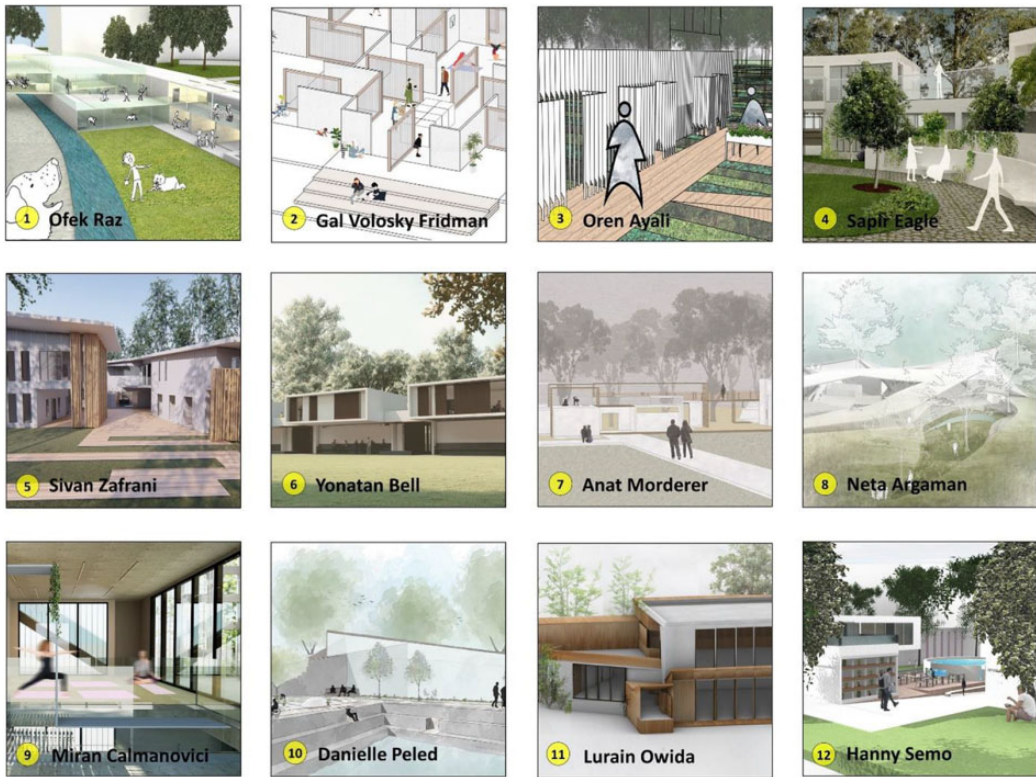


Figure 5. Images of the student's designs for the Maggie's Center in Israel.

or the garden at the agriculture cancer center (Project 3).

In their designs, the students rejected the standard requirement to design for a generic cancer patient. They argued that cancer patients differ in age, medical condition, stage of illness, social and family support, culture, and personality. They insisted on confronting the challenge to design for a range of very different needs and expectations of the end users. Many thought that the center should help patients overcome fear and take control and responsibility for their illness to attain relief. Accordingly, the design projects offer different care strategies including playfulness by a dynamic, flexible structure (Projects 2 and 7) and therapy using agriculture and arts and crafts (Projects 3 and 11). The students aimed to create a variety of spaces with different atmospheres by using natural light, water, and color (Projects 8, 9, and 12). Most of the design projects consisted of

a strong connection to nature as a spiritual experience and included landscape design as a significant theme (Projects 4, 6, 8, and 10). In their design, the students reflected on the need to symbolize the purpose of the center—bringing hope—and questioned whether architects should represent themselves in the center design.

Results of the Students' Survey

The students in the EBD studio participated in a survey to reflect on their experience in the course 6 months after its completion. The survey complemented the interviews of the students by the studio advisor during the course and after their final presentation to evaluate the impact of the EBD approach on the students' design process and design outcomes (Table 1). The survey revealed that the EBD method was new to all the students in the course (100%), all of them

Table 1. Students' Survey.

Questionnaire Topic	Scale/Option	Mean Response
1. Was the evidence-based design (EBD) method new to you?	Yes/no	Yes (100%)
2. Did the EBD process impact your design?	Yes/no	Yes (100%)
3. How much did the predesign tasks impact your design?	0 = None . . . 10 = highest	
• Literature review (academic articles)		7.6
• Learning from Maggie's (comparative analysis of the existing centers)		9.1
• Analysis of the project context (hospital site and cancer care in Israel)		8.3
4. How much did the EBD process impact your design project?	0 = None . . . 10 = highest	
• Conceptual design (manifesto and abstract model)		7.0
• Master planning (location in the hospital campus)		6.8
• Designing the Maggie's Centre (final proposal)		8.1
5. Will you implement EBD in your future projects?	Yes/not sure	Yes (92%)

testified that the EBD process impacted their design (100%), and most of them were confident that they would implement it in their future design projects throughout their academic studies and architectural practice (92%). The students rated the relative impact of the three predesign tasks on their design project. Learning from Maggie's, the comparative analysis of the existing Maggie's Centres received the highest mean impact score of 9.1. The study of the project context, the hospital site, and cancer care in Israel received a mean impact score of 8.3, and the literature review of academic articles received a mean impact score of 7.6. The students also scored the relative impact of the EBD process on the three main stages of the design project: the conceptual design stage received a mean impact score of 7.0, the master planning received the lowest mean impact score of 6.8, and the main task of designing the new Maggie's Centre received the highest mean score of 8.1 (Table 1).

The results of the survey illustrate the students' experience during the EBD design studio. All of the students recognized the high impact of the EBD process on their design project and its potential influence on their future practice. While the literature review of academic articles had a high impact on their design project, they placed a higher value on the analysis of precedents of existing Maggie's Centres. This is also reflected in the high score of the EBD process impact on the design stage of designing a new Maggie's Centre. The

results might reflect the studio's primary objective to develop an individual comprehensive design proposal for the new Maggie's Centre and the challenge to complete it on time for the final presentation and public exhibition. Interviews with students indicated that many found it challenging to balance research and design in the tight schedule of a one-semester studio, and they wished they had more time to search for more evidence during the advanced stages of the design.

All of the students recognized the high impact of the EBD process on their design project and its potential influence on their future practice.

In the comments section, many students expressed greater pride in their achievements than in previous design studios. Some students reported that they are already implementing an EBD process in their current design studio in urban planning and residential housing design. They acknowledged that their ability to present supporting evidence increased their confidence in their conceptual solutions and design decisions. It provided a practical tool to predict whether their design objectives would be fulfilled and to support their claim. Many students wrote that the evidence presented a new perspective and a new approach to the project design, which they would not have achieved without the EBD process. This was especially important to students who had

personal experience with cancer care and searched for objective evidence to support their subjective insights. The use of evidence from different types of research studies in the predesign tasks (Figure 1) provided an extensive understanding of spatial, environmental, and human design correlations. Students contended that the combination of a few sources of evidence contributed to new insights and innovative ideas.

Discussion

The study examined the implementation of the EBD approach in architectural education and revealed the impact of the approach on the design process and design outcomes. The results demonstrated the influence of the predesign research tasks on the different stages of the design project. The integration of a literature review of academic articles with traditional design methods of precedents studies and project context analysis provided the students with a wide range of knowledge and evidence to support their design decisions. The predesign tasks contributed in different ways to the individual design work of the students. Some students found inspiration from the evidence presented in academic research, while for others the design was driven more by their findings of the specific context of the project. The analysis of the existing Maggie's Centres as examples of EBD interpretation by leading architects had the most significant effect on the students' design proposals, probably because of its clear relevance to the studio's primary objective to design a new Maggie's Centre in Israel. The most advanced students successfully combined the three predesign tasks to one comprehensive body of knowledge to support their design concept and design solution.

The EBD approach supported the students at the different stages of their design process. Some students relied on evidence to develop their written manifesto and schematic models in the conceptual design, and others used the evidence to explain their chosen location for the Maggie's Centre as part of the hospital master planning. The design of the Maggie's Centre by all of the students was directly influenced by the predesign tasks. The students expressed their ideas through various themes based on their personal

experience and intuitive approach supported by evidence. The main challenge for the students was to combine their findings from the analysis of Maggie's Centres with the study of the local context of the project. They frequently discussed what is universal and what is local in our conception of a healing environment and how we can know whether evidence from other places in the world is relevant to healthcare projects in Israel.

During their work on the project, the students developed skills in applying research-based knowledge into conceptual design strategies and interpreting them to the specific context of their project. For example, the knowledge of the healing impact of nature resulted in designs that incorporate outdoor spaces within the center in relation to climate challenges and existing landscape at the hospital site. Additionally, the knowledge of the empowering impact of control over the environment led to designs that provide flexibility of use and diverse atmospheres in relation to local perception of social control.

Overall, the results of the studio, 12 architectural projects represented in drawings, 3D models, and a written manifesto demonstrated the students' enhanced awareness of the impact of architectural design on the users' health and well-being and their ability to create a variety of innovative visions for the new center in Israel. EBD enhanced the students' confidence to develop and present their design initiatives based on acquired knowledge. The evidence provided a broader context behind their design ideas and solutions. It also helped them explore a new topic, expand the theoretical framework, and build on top of their curiosity systematically. In this respect, the research supported the students' creativity and innovation. It resulted in a sense of achievement in the design studio that was shared by the architectural experts who reviewed the final project presentations.

The results of the survey correlate with the evaluation of the advisor. All of the students recognized the high impact of the EBD process on their design project and its potential influence on their future practice. Most of the students recognized the advantage of basing design decisions on scientific evidence. Yet, since this process was new to the students, it required

flexibility to address the specific needs of each student according to their progress in the design project. Some students expressed the challenge of transforming scientific findings into conceptual design strategies and interpreting the relevance of general evidence to the specific local context. The interviews and survey revealed the difficulty of providing research knowledge and balancing research and design within one semester of an architectural design studio.

Conclusions

The study demonstrates the advantages of practicing EBD at an early stage in healthcare architectural education to enhance awareness of the impact of architectural design on the users' health and well-being. Our results indicate the potential of incorporating evidence from academic research in architectural practice to support the design process and to contribute to the design outcomes both in architectural education and in the students' future professional practice. These findings correlate with the approach that EBD should be part of the process of decision making about the creation of environmental design by critically and appropriately integrating the sum of credible evidence, practitioner design expertise, client or population needs, and preferences and resources, in the context of the project, in order to achieve project objectives (Peavey & Vander Wyst, 2017); however, more studies in architectural education and practice are needed to assess the full impact of integrating EBD in architectural design processes.

The study provides a conceptual framework for architectural education and practice to integrate traditional design methods based on experience, creativity, and intuition, with the use of research studies as a source of knowledge. The design process that combined EBD with conventional methods of the architectural studio, including precedent studies and project context analysis, developed the ability of the students to critically interpret the evidence and design their project to reflect their own interpretation. The EBD studio experience developed the students' capacities for critical, reflective, and sensitive design. Although the study is limited in scope,

the final results of the design studio indicate that an EBD approach in academic settings supports the creative process of students. Consistent with other research findings, the results of this study reveal that creativity and EBD can be synergistic partners. While one provides the basis of ideation and concept development via the imagination, the other provides the specifics of need and refinement of purpose (C. S. Martin, 2009). It affirms that architecture students, as well as architecture practitioners, should have a broad understanding of EBD as a method to supplement traditional design methods.

The design process that combined EBD with conventional methods of the architectural studio, including precedent studies and project context analysis, developed the ability of the students to critically interpret the evidence and design their project to reflect their own interpretation.

Limitations

This study was conducted at an academic architectural design studio at the Faculty of Architecture and Town Planning at the Technion-Israel Institute of Technology with 12 undergraduate students by the course instructor. Further work is required to expand the study and to validate the results in additional architectural design studios with more students and to compare the approach at different educational stages in various academic institutions. Further research should also compare the EBD approach to traditional methods of architectural design studios, and the results should be validated by objective researchers. The survey of the students was conducted 6 months after the completion of the course. Future studies should investigate the implementation of the EBD process in the students' work over time both in their final design project and in their architectural practice.

Implications for Practice

- The significantly different designs of Maggie's Centres developed for the same

architectural brief and based primarily on the same evidence illustrate that an EBD process can support architectural creativity and innovation.

- EBD process should question what is universal and what is local in our conception of a healing environment and how the design can support diverse age and gender users from a different cultural, ethnic, and religious background.
- Architectural education programs should advance research knowledge to support the challenge of balancing research and design in academic design studios.
- Integrating EBD with conventional methods of precedent studies and project context analysis at an early stage in architectural education can advance students' ability to interpret evidence critically and enhance their creativity and confidence.

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