A Place to Discover, Imagine, and Change: Smart Learning with Local Places

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Abstract. Following the results of a study focusing on the unique affordances of mobile technologies that support their informed integration in learning, a novel pedagogical model has been developed. This model was tried out within the context of geography and cultural heritage in four different cases. The first part of this paper briefly presents the main findings of the study and sketches the emergent uniqueness profile of mobile apps for learning. The second and main part outlines the DICE model (Discover, Imagine, ChangE) that was developed for designing place-based learning activities with the assistance of mobile apps, and presents its main characteristics through data gathered from the four cases. Through participating in DICE activities, learners uncover the invisible in familiar places and become more aware of their surroundings, while the place becomes a powerful object to learn with.

Keywords: Blended spaces · Environmental knowledge · Mobile learning · Place-based learning

1 Introduction

The concept of 'place' is known to be simple and complicated at the same time, while "no-one quite knows what they are talking about when they are talking about place" [1, p. 1]. According to one definition, a place is a meaningful location. This definition encompasses the engagement of people with placemaking and the human need for a 'sense of place' [1, 2]. The consolidation of the web, the mobile and locative media [3], and the internet of smart things (IOT) [4], opened new possibilities of interaction between the individual, her or his community, and their places of living, working, and visiting. Technologies such as mobile field survey, AR, location-based games and digital objects embedded in the place, enable strengthening the attachment to the place for both individuals and communities. Such technologies help in making places and their values more accessible while creating new formal and informal learning opportunities [5, 6]. As a result, the processes of giving meaning to places have also changed. These processes not only document and teach about the place in which the community operates, but also act and interact within the place. The variety of interactions might

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change both the relations with the place and the meaning given to it, in addition to actual changes (physical and digital) in the environment. The paper discusses these new possibilities through the pedagogical lens of "Discover, Imagine, Change" abbreviated as DICE. This is an educational process formulated as an implication of a recent study on the uniqueness profile of educational mobile applications [7].

The educational use of mobile applications is thought to have significant learning potential. Smartphones are already massively embedded in daily life but integrating mobile technologies within learning environments is a complex and challenging mission which requires innovative pedagogical thinking and strategic changes, beyond merely implementing e-learning methods with the aid of mobile devices. In recent years, much research has been conducted on the integration of mobile apps into educational settings [8, 9]. However, the task of identifying the unique features and affordances of mobile technologies has been a complex one [10]. The research from which DICE has emerged sought to focus solely on learning processes and outcomes that are possible only when using mobile apps, and to identify their unique and exclusive affordances. Within this framework, a unique educational mobile application has been defined as an application that has learning affordances attributed exclusively to mobile devices and apps, with benefits that are unattainable in outdoor learning environments, when no digital technologies are involved. As Fig. 1 suggests, the term MUC has been used to label such a unique mobile app.

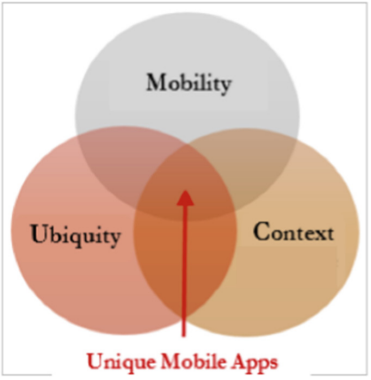

Fig. 1. MUCs - unique mobile apps selected for the study

While both the "M" (mobility) and the "U" (ubiquity) imply independent learning anytime and anywhere, the "C" (context) suggests some dependency on the decisions and actions of the instructional designer and the learner. The distinctiveness of MUCs thus lies in their ability to be deployed at any time and in any location, while nevertheless being sensitive to the context - the environment, the user, and the learning activity. This combination is what makes mobile apps unique for learning purposes.

The next section of this paper sketches the analytic process conducted as part of a study of more than two hundred mobile applications for learning, focusing on selected MUCs. The third section outlines the DICE idea - a novel pedagogy based on

collaborative mobile and place-based learning using MUCs, developed and tried out in four different communities of learners in Israel. Through participation in such mobile-enhanced activities, learners not only discover the place they live in but might also contribute to its change. Section 4 discusses the lessons learned from implementing the DICE model in these four cases. The last section summarizes the significant educational values of the model and concludes that learners can develop a deeper understanding of their environment as an outcome of the *Discover* → *Imagine* → *ChangE* process.

2 Constructing the Uniqueness Profile of MUCs

When discussing and studying mobile learning [11], three types of affordances are often mixed: (1) affordances attributed to non-mobile desktop applications, including complex design systems such as AutoCAD; (2) universal applications operating both on non-mobile and mobile computing devices, thus available anywhere and anytime; and (3) affordances attributed exclusively to mobile apps. While many studies focus on learning with mobile applications as part of using a broader technology-enhanced learning toolbox, the study briefly presented in this section sought to focus solely on those learning processes and learning outcomes that are made possible only when using mobile apps and to identify those unique and exclusive affordances.

The analytic process was conducted as part of a more extensive study of more than two hundred mobile applications for learning [7]. Most of these apps have been available for free use by any teacher or learner, on any conventional mobile device, and did not require special hardware or external gadgets. Two research questions directed the study: first, what makes mobile apps unique for educational purposes? And second, what are the unique affordances of mobile technologies that support their informed integration in learning environments? The gradual qualitative analytic process began in 2015 and resulted in five emergent themes of uniqueness of mobile apps, organized into three levels, as is shown in Fig. 2.

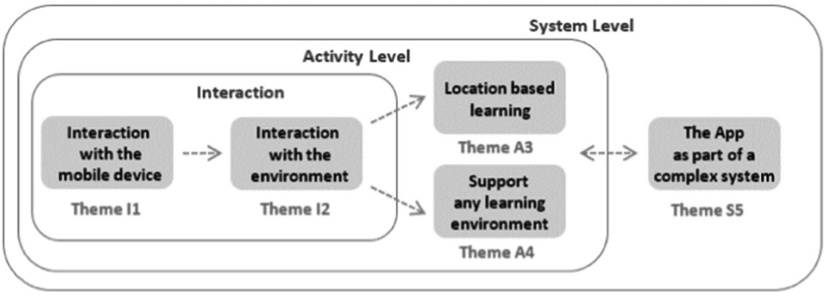

Fig. 2. The emergent categorical system

Common to these emergent categories is the experience of learning in blended spaces [12, 13]. This primary pedagogical principle led to additional principles such as embodied cognition, the device as a discovery machine, and open playful design.

Taken together, these principles draw a uniqueness profile for MUCs that supports system thinking and deep understanding of the environment in which the unique mobile app is used. The emergent profile of uniqueness encircling these principles is drawn in Fig. 3.

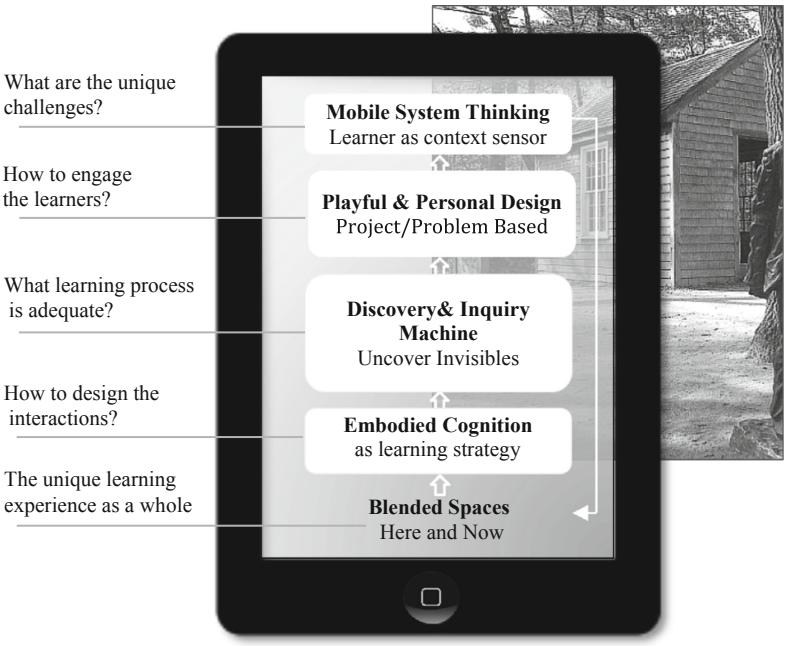

Fig. 3. The uniqueness profile of mobile apps for learning

According to the results of the study, the overall uniqueness profile stems from the fundamental principle Blended Space – *Here and Now*, while each additional principle has some relationship with this major unique learning principle as well as with the others. Therefore, the fundamental principle is drawn at the bottom of the uniqueness profile. In other words, the study suggests that these principles should be treated not just as a list, but as a structure in which the components are placed layer upon layer so that each layer serves as a base for the next, and all are made possible by applying the founding principle. Figure 3 also presents the main question that needs to be considered in applying each of these principles. In learning environments and experiences involving these principles, the learners operate as 'context sensors' with the aid of unique mobile apps.

3 DICE: Smart Learning with Local Places

The uniqueness profile facilitates the use of the pedagogical principles for a deep understanding of the environment and promotes new literacy of mobile system thinking. To enable such use, mobile place-based learning activities should integrate

innovative technologies and pedagogies that allow the learners to perform as a "context sensor" of their environment [14, 15]. This section outlines DICE (*Discover, Imagine, ChangE*) as a novel pedagogy for dealing with such integration.

The proposed model serves as an implementation of place-based learning with the assistance of mobile and other 'smart' technologies [5]. It aims to use the uniqueness profile [7] in such a way that the student becomes more aware of the surrounding while the place becomes a powerful or 'smart' object to learn with.

The pedagogical process includes elements of mobile inquiry and discovery, mapping and documentation using locative media, location-based games, and knowledge sharing. These elements are based on the results of the research presented in Sect. 2 and on the uniqueness profile of mobile applications for learning (Fig. 3). As will be exemplified in the following four cases (Subsects. 3.1–3.4), the DICE model can be implemented in diverse communities considering their unique cultural heritage and places, taking into account specific needs and local themes.

The DICE pedagogical model involves three components or learning phases; each answers a different question.

1. *Discover*: *What was here, and what is here now*?
   Activities at this phase include inquiry into the place ontology - its past, and its present. Such activities enable learners to reveal and express the unique "sense of the place" [2], and to document, map and share knowledge and findings. This component can be implemented as a standalone learning activity and might incorporate a field survey using mobile inquiry apps and archeological, historical or environmental survey.
2. *Imagine*: *What might be done here in the future*?
   Learners are asked to think creatively about the future of the place and to make suggestions for future communal projects and interventions, based on the knowledge they created in the first phase.
3. *Change*: *How to intervene in the place*?
   This phase refers to physical "placemaking" projects as well as virtual interventions, as an implementation of the designs from the *Imagine* phase. The *Change* might be in the form of increased public awareness or/and improved accessibility to the place. Such changes are also a result of sharing information and knowledge at the *Discover* phase.

The DICE model has been developed and tried out within geographical and cultural heritage context in four different communities of learners in Israel. In two of them, the activity was connected to an ongoing conservation project. The activities took place in rural and urban settings, with learners' age ranging from sixth graders to students in academic project-based courses. The rest of this section details these four case studies.

3.1 DICE as Part of the Excavation of an Ancient Galilean Synagogue

The first case tells the story of implementing the DICE pedagogical model by an elementary school in the Galilean community of Yesod Hama'ala, in collaboration with the Israel Antiquities Authority. The project was part of the excavation and conservation of the ancient synagogue and Crusaders sugar factory remains found near the

village of Yesod Hama'ala. The school children and teachers participated in the excavation during three successive years (2016–2018).

During the first year, in addition to the excavation, the children also explored the historic part of their village that was established in the 19th century. The exploration was done as a mobile inquiry activity using a dedicated mobile app (Fig. 4b). In this *Discover* first phase of the DICE model, the learners surveyed historic houses and courtyards in the village, with the help of the house owners. Their task was to search and document the locations and properties of historic artifacts and antiquities that can serve as evidence for different periods at the village. The result was an online map of the artifacts that the children shared with the community (Fig. 4a). Then, they continued to study the artifacts and used them to design a 'treasure hunt' game for and with the broader village's community.

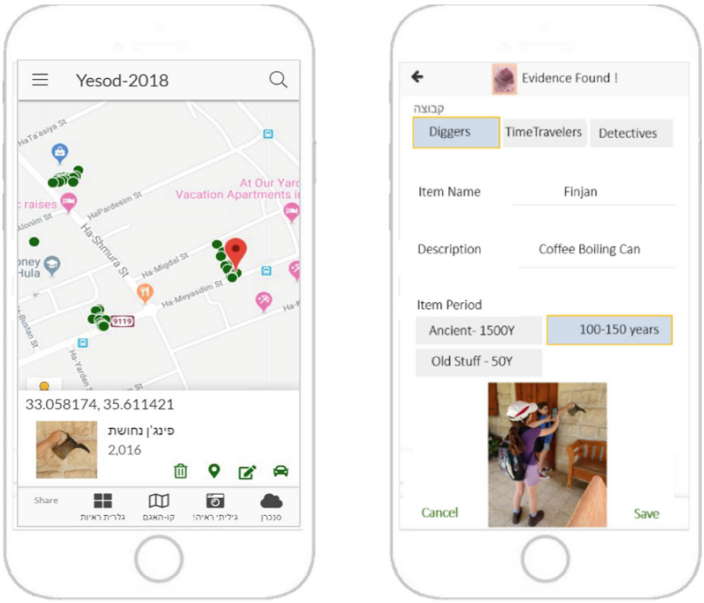

Fig. 4. (**a**) The shared artifacts map. (**b**) The mobile app used for the survey

Following the first DICE phase, the elementary school students were also engaged in the second *Imagine* phase when the thought about future archaeologists visiting their village. They decided to prepare a time capsule for these future visitors and explorers. The capsule consists of personal seals the children prepared, as well as a memory stick with the artifact's pictures and description from the survey. The children buried the time-capsule in the archaeological site (see Fig. 5c), thus contributed to a minor but meaningful *Change* of their place.

The second year of the project was centered around the idea of a placemaking design process, in the archaeological site. The first *Discover* phase included mobile inquiry of

the immediate surrounding of the ancient site they excavated previously, where they searched for evidence of the lost Hula lake that was drained seven decades ago. The children also documented their impressions from the site's 'sense of place' [1, 2].

Then, as part of the Imagine phase, they were asked to envision the site in the future and to design their intervention to conserve and develop the site for the benefit of the community. Finally, one proposal from the Imagine phase was implemented as part of the last Change phase: an original seating area was constructed onsite (Fig. 5d). At that seating area, the children embedded a small digital object that refers to a website detailing the story of the site and the project.

Fig. 5. (**a**) Example from the *discovery* phase: documenting artifacts. (**b**) Example from the *Imagine* phase: planning a sculptures garden. (**c**) Example from the *Change* phase: burying the time capsule. (**d**) Example from the *Change* phase: construction of the sitting area

As is illustrated in the details of the Yesod HaMa'ala case, the principle of using mobile apps as an inquiry and discovery machine plays a key role within the DICE model. The principle was implemented through an open and playful learning activity, of reviling and mapping local pieces of evidence of the history of the village (Fig. 5a). The children were enthusiastic about the mobile inquiry, the immediate "here and now" results on the online map, and the ability to share their discoveries with the community.

Another implication regards the power of imagination in the learning process. The second *Imagine* phase of the DICE model has proved to serve as a powerful trigger for students' engagement with the project (Fig. 5b). They approached it with fun and

intrinsic motivation, probably due to both their involvement with the place in the previous *Discover* phase and the opportunity to express their ideas and influence their environment in later phases.

The Yesod HaMa'ala case also raises the issue of the complexity of making physical changes in a place. A physical change has a significant educational value, but at the same time, it also has some practical and administrative limitations. One recommendation to consider is therefore to involve virtual changes such as mobile geocaching, Google 360° documentation, and mapping of a place in creating the change within a blended space [12]. Indeed, throughout the different DICE phases in this case, we noted the relevance of the fundamental principle of blended. For example, a group of children proposed to create an augmented reality gaming activity with IOT objects for visitors in the archaeological site. Such ideas might reflect that young learners nowadays experience blended spaces as part of their culture.

3.2 DICE in a Community College: Making Peripheral Places More Accessible

The second case is related to a short-term project that took place as part of a social media course in the CIS department (Community Information Systems) at Zefat Academic College. The college is located in the northern periphery of Israel, in the heart of the ancient city of Zefat. The city is one of the most important historic cities in Israel with unique cultural significance. However, it lacks documentation, and many of its sites are neglected and deteriorating. The CIS program seeks to prepare and grow local Information Systems workforce by advancing understanding of computing, design, HCI, digital culture, entrepreneurship and other subjects regarded as critical to developing the needed workforce for the 21st century. Since mobile system thinking is regarded as one of these essential skills, it seemed valuable to implement the DICE model with CIS students.

The academic project focused on the first and the last components of the DICE model. During the *Discover* phase, students were asked to select a special place in the college area[1] or elsewhere in the Galilee and to document it using the Google 360° mobile app. A collaborative shared map containing all of the students' contributions has been constructed, updated and distributed within the college (Fig. 6 brings a partial map of the chosen places). A *Change* activity was also implemented using Geocaching - hide and seek. A cache was hidden in the Crusader citadel of Zefat[2], adjacent to the college, and was followed by a cache seeking gaming activity with the students. The cache became available for the public to discover, imagine, and change as well.

In addition to the principle of using mobile apps as a discovery machine, the Zefat case highlights the unique principle of Embodied Cognition (see Fig. 3 above). That principle was implemented through the physical actions needed for a successful recording of a panoramic picture of the place using the mobile app. For creating an

[1] See a link to the college's library on Google Street View, created by one of the CIS students https://goo.gl/maps/g4r5qw9KFCA2.

[2] The Zefat Citadel geocache: https://www.geocaching.com/geocache/GC7FQZG.

impressive and accurate 360° panoramic object, the creator must be fully aware of the details of his or her surroundings, while turning around slowly. Such use raises students' awareness of environmental elements as well as to their physical presence within the frame. Furthermore, when a 360° panoramic object is recorded and uploaded successfully, it can make a real contribution to the accessibility of unique and remote places. In some of the remote places documented by the college students, their contribution was the only 360° street view documentation on Google map in the area. As a result of such authentic acts of crowdsourcing, the visibility of those sites has been raised, and the accessibility to peripheral locations has been improved. One example is the Circassian village of Rihaniya shown in the center of the map in Fig. 6. The panoramic view of a place at the historic center of Rihaniya was chosen and recorded by a student living in that village. As it turned out, it has been the first and only documentation of that place in Google Maps[3] since the villages in this remote area were not documented by Google except for the main roads.

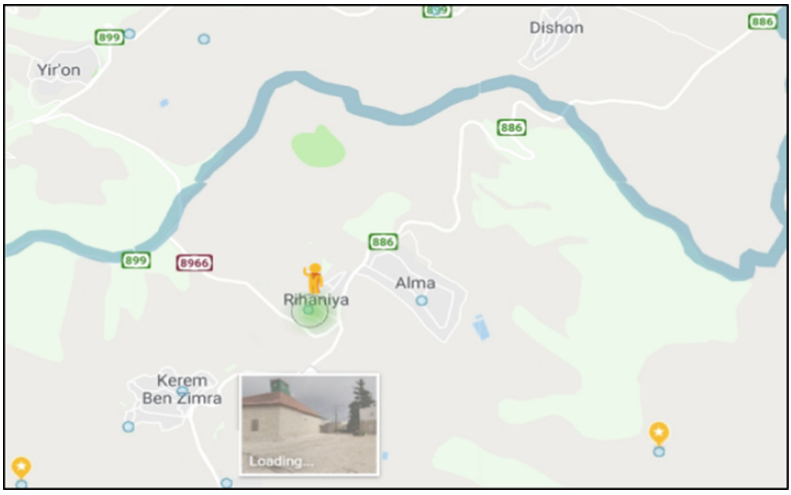

Fig. 6. Changing the online map of Rihaniya

The Zefat case also demonstrates Geocache as IOT placemaking. The *Change* component of the DICE model, in this case, has been mostly viable through non-physical terms such as increased awareness and accessibility to the place. However, the experience of Geocaching also contributes to a small physical change, that requires mobile system thinking, and environmental awareness. Interestingly, even after the DICE implementation has ended, the Department of Community Information Systems took responsibility for maintaining the cache in its area. This has also an educational value related to the department's goals.

[3] The Rihaniya historic center on street view: https://goo.gl/maps/nPEbWQ2Rvst.

3.3 DICE as Part of the 'IT Applications for Studying a Place' Course and the 'Uncovering the Invisible in the Familiar' Effect

Both the third and the fourth cases were carried out at the Department of Geography and Environment at Bar-Ilan University. The university is located in Ramat Gan, a city adjacent to Tel Aviv, within the largest metropolitan area of Israel.

The BA course titled "IT applications for studying a place" has been offered by the Department of Geography and Environment for the last couple of years, using project-based learning (PBL) approach. Recently, the DICE model has been integrated within the course, when students have been requested to select a place according to their interests and to conduct an inquiry in and about the place throughout several *Discover* activities. Those included exploring the 'sense of the place' as well as engaging in historical and geographic documentation, collecting field data and mobile mapping. Like in the Zefat case described in Sect. 3.2, each Bar-Ilan student recorded a 360° panorama of his or her selected place and uploaded it into Google Street View. The students were also required to prepare a final documentation report and to share it online through a personal web site. In future courses, the students will also be requested to propose their future vision of the place, as an implementation of the *Imagine* component of the DICE model.

As part of the Bar-Ilan course, a special workshop has been designed and conducted, focusing on mobile learning of places. The workshop has been tailored to the specific characteristics of the sites and the places chosen by the students with the aim of experiencing the place by using unique mobile apps (MUCs). Those included location-based game, partly created by the students; street survey apps; and an AR navigation activity following a historical aerial map on a dedicated mobile app.

Over the years, the mobile learning workshop keeps receiving the highest ranking among course activities, probably due to the playful and innovative ways of learning it offers to the students. Surprisingly, even after a decade of the everyday and extensive use of smartphones and mobile apps, our typical students have not been familiar with regards to unique mobile features and MUC apps in general, nor were they familiar with mobile apps for studying places and environments in particular.

As in the case of Yesod Hama'ala (Sect. 3.1), the principle of the discovery machine played a key role in the current case. Even when the students were familiar with the place, they often revealed new and unexpected features of it. The discovery phase was assisted by 'here and now' blended-space objects such as AR historical maps. This blended-spaces experience brought about curiosity to gain a deeper understanding of the place. The excitement of re-discovering has been noticed in students' feedback when they described how surprised they were to find out new and meaningful characteristics of familiar places they thought they had known well. Therefore, we suggest naming this effect "uncovering of the invisible in the familiar". Students also testified that the mobile inquiry helped in strengthening their attachment to their studied place. For some of Bar-Ilan Geography students, it even served as a trigger for further independent exploration (after the course itself has ended). Therefore, the *Discovery* phase of the DICE model might have a lasting effect on lifelong learning of places and environments.

3.4 DICE in the Context of the Old City of Jaffa Conservation Survey

The last case is also a project-based learning course offered at the Department of Geography and Environment at Bar-Ilan University. This MA course is a part of the program for Preservation and Development of Landscape and Cultural Assets. The students, guided by professionals in the field, conduct an urban conservation survey in an area under planning processes. In the *Discover* phase, students survey the area, collect data and produce a report with the findings. In the *Imagine* phase, the students are asked to propose suggestions for a conservation plan. The report is made available to local authorities, and in some cases, it might inform their conservation plan, and thus might have an actual effect on the *Change* of the place.

The focus of the 2018 survey has been on the northern slopes of the Old City of Jaffa. The students recorded and mapped hidden historical elements in the area, through a dedicated *Discover* mobile app. The app enabled the students to locate themselves on historic aerial maps, to record the historic elements they discovered, and to locate them on the map. In Fig. 7 below, the app interface is displayed, showing the mapping of remains found by the students together with a picture of one student standing in the present location where according to the 1936 aerial map the small 'Hammam' (a Turkish bath) used to be.

Fig. 7. Using a mobile app for multilayered mapping of remains in a conservation survey

The "uncovering the invisible in the familiar" effect has been particularly evident in the Jaffa survey, because of the multi-layered complex nature of its heritage. In the survey area, the historic buildings were destroyed, and in later years a garden was planted over the rubbles. The garden today is very popular among locals and is well known to tourists. Although the MA students were familiar with it too, they were surprised to discover that the historical remains in the garden which they never noticed before. Until they were required to be engaged in a *Discover* mobile inquiry activity, those remains, and some other parts of the Old City's past, were transparent to the students. In that sense, the unique mobile app together with the DICE learning activities might contribute to discovering such a multi-layered place, incorporating various and conflicting narratives that are not easily accessible to the typical visitor.

The Jaffa case also serves as an example for dissolving boundaries between the classroom and the world, which is one of the main implications of the uniqueness profile described previously [7, 16, 19]. The area is undergoing re-evaluation for planning, and the mobile inquiry app allows to document and share the survey findings. Such digital mapping also serves as a reference point to the *Imagine* phase in the course and the *Change* phase that takes place in the authentic planning process, outside the framework of the student's project. In this case, the *Change* component has a relatively high potential.

4 Discussion

The above four cases followed the DICE process of *Discover* → *Imagine* → *Change*. In all of them, the first learning phase has been central to the model and a necessary one, while the other two have been sometimes implemented mainly virtually. In what follows, we will elaborate on the lessons learned from the four cases with regards to the unique principles apparent in each learning phase.

4.1 Discover

Throughout the *Discover* phase learners come to know the place they study, often with the aid of learning principles such as using mobile apps as a discovery machine. As it happened in the abovementioned cases, this creates the powerful effect of "uncovering the invisible in the familiar", while transparent elements had been invisible in the site until someone acted as a lens to point them out [16]. In many cases, when there no human guide is there, such uncovering can only be achieved using mobile or IOT technologies at the right time and in the right place. The immediate effect of such mobile self-discoveries is of primary importance in creating the connection and attachment of learners to the place.

Other learning principles contained in the uniqueness profile of MUCs were also apparent throughout the *Discover* phase. According to the principle of embodied cognition, the understanding of a place is constructed through the experience of being in it and moving around it [17]. The ability to place and show local findings from the site on an online map also contributes to creating a blended space experience. Naturally, open and playful learning design has also been used in the *Discover* activities.

The *Discover* component serves as a basis for the other two components. Its outcomes activate the imagination by connecting the question of "what was/is here" of the first phase to the question of "what can be here in the future" of the second phase. At the same time, the findings from the inquiry constitute the understanding of the characteristics of the place as a basis for the *Change* phase.

4.2 Imagine

The rationale for the *Imagine* component of DICE derives both from architectural design practices and from constructionist approaches for learning by design [18].

In the abovementioned case studies, the *Imagine* component played an essential role in motivating the learners while the question "what can be here in the future" led to unlimited directions and ideas. For example, while one team in Yesod HaMa'ala built a model for an ancient playground, another proposed an outdoor art gallery. Other idea suggested a kinetic sculpture operated by actual visitors or from afar, using IOT-enhances placemaking. The outcome of the imagination phase depends mainly on the discovery findings and the instructions for the *Change* component. Knowing that the proposed designs might have a real impact on a place has been both challenging and motivating, allowing for an authentic yet creative process.

In the *Imagine* phase, the use of mobile applications has not been as significant as in the *Discover* phase. However, design applications, or VR applications of an existing place with the addition of VR/AR imaginary 3D elements to it[4], can indeed be used to spark the imagination further. Furthermore, mobile apps for collaborative idea sharing and the use of the 'wisdom of the crowd' using social media apps might have additional potential for the *Imagine* phase.

4.3 Change

The component of *Change* in DICE comes in different modes, from a physical intervention at the end of the design process to a change in public awareness. *Change* can also be in the form of creating virtual access to a remote location, or access to place-based information "here and now" for visitors on site.

Listed below are the different modes of *Change* in the place and in its context that were identified in the abovementioned case studies.

1. Physical intervention in the site can be implemented using a placemaking approach at the end of DICE's overall process. Making a physical change can be complicated as it naturally depends on various constraints, but it is recommended to include even a small portion of physical change due to its high educational value.
2. A proposal for a physical change in a place. Even without an actual intervention, the proposal in itself might be significant both in its contribution to the community and in deepening the learners' understanding of the place. For example, in the case of Bar-Ilan conservation survey, the actual *Change* was not a part of the course

[4] Platform for creating AR/VR objects linked to real places: https://edu.cospaces.io/Studio.

framework, but it did inform the local authorities in their actual planning for the Jaffa garden on the slope.

3. Creating blended space objects that connect a virtual domain to a physical one. For example, *Change* can be achieved by adding a physical geocache onsite or by burying a time capsule that relates to the findings from the *Discover* phase. Hiding a geocache requires real-world considerations, such as the knowledge about the local population, social norms and the values of the place. Being aware of such considerations has by itself a significant educational value.
4. Virtual change of the place's accessibility and meaning. For example, by documenting and mapping interesting elements on an online map during the mobile inquiry, and by sharing the online map with the broader community through social media channels, the place is made more accessible, visible, and familiar. Although virtual, such change impacts the meaning of the place for the learners as well as for the wider community.

5 Conclusions

The Uniqueness Profile (Fig. 3) suggests that mobile devices and apps might serve as the context sensors of a discovery machine in different environments and places, enabling embodied cognition interactions through sensory affordances like AR, GPS or 360° panoramas. MUC apps and learning activities also enable constructing smart blended space artifacts in context, documenting sensations, and sharing it between near and distant actors in an open and playful approach.

As part of the overall DICE pedagogical model described in this paper, learners can develop a deeper understanding of their environment, through learning activities based on the Uniqueness Profile principles. Blended space objects, e.g., mapping invisible items, geocaches, location-based games or time capsules, can be created by learners themselves as an outcome of the *Discover* → *Imagine* → *Change* process. This, in turn, leads to an enhanced mobile system thinking, which includes improved environmental and contextual awareness.

Two additional educational values are noteworthy. First, the unique principle of discovery machine on which the DICE's first phase is based supports the effect of "uncovering the invisible in the familiar". This effect might be one of the reasons for the growing sense of attachment reported by users involved in a mobile inquiry of familiar places. Interesting potential for further research grows out of this, especially in light of the common perception of mobile technology as an agent of disconnection from ourselves and our environment. Second, mapping and sharing mobile inquiry findings might also contribute to learning processes outside of the classroom. This is how the boundaries between the educational realm and other social institutions like municipalities might be dissolved. Furthermore, with MUC apps we can now annotate our environment [19], so that the places become like books and the world turn into a library.

Although the *Discover* phase can standalone, the *Imagine* and *Change* components are very important, even in a small portion or in virtual mode. These phases of the DICE model serve as an intrinsic trigger to an authentic and more engaged process. When

adding the *Imagine* and *Change* components to the *Discover* phase, the world might become more than 'just' a library as it turns into a laboratory or a "Construction Kit", when "it is re-seeing the world as something that can be re-made that is the goal" [16].

In this article, we described the implementation of four DICE cases that were different in their goals, places, and learners' characteristics. Some were done in cooperation with the authorities in the context of planning and conservation projects. All cases have been conducted in educational institutions. However, further implementation can be made by place-based organizations that can adopt the DICE model in the context of community projects and cultural initiatives. Additionally, a global open online course for "learning a place" can be developed based on the DICE model, where students undertake a learning project in their area and share their findings and ideas in the online system. Such a global initiative will enable discussion and dialogue with students and mentors around the globe. An academic course of this type may be relevant to the study of various environmental disciplines and activities in urban and rural environments.

To summarize, when participating in mobile-enhanced DICE activities, learners not only discover the place they live in but might also contribute to its actual change. The learners in such activities are a small step ahead of being just mobile consumers and even producers of digital information. The DICE model suggests using unique mobile affordances in conjunction with non-mobile and analog activities. In this way, learners become more aware of their surroundings, while the place becomes a powerful object to learn with.

A major challenge in applying the affordances of MUC apps is by using these unique mobile applications not merely as 'context sensor' extensions of the human body and mind. It is rather the way for the learners themselves to become 'context sensors', curious and aware of their surroundings. It is especially important as mobile apps already serve as a digital interface to the world; the world itself is increasingly turning digitized, and objects are becoming more connected and 'smarter.' This fascinating combination generates new objects to think with, new blended spaces to live in, and may also generate new ways of being, experiencing and learning.

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