

Designing Games to Teach Ethics

Peter Lloyd · Ibo van de Poel

Received: 9 August 2007 / Accepted: 28 May 2008 / Published online: 14 June 2008
© Springer Science+Business Media B.V. 2008

Abstract This paper describes a teaching methodology whereby students can gain practical experience of ethical decision-making in the engineering design process. We first argue for the necessity to teach a ‘practical’ understanding of ethical issues in engineering education along with the usual theoretical or hypothetical approaches. We then show how this practical understanding can be achieved by using a collaborative design game, describing how, for example, the concept of responsibility can be explored from this practical basis. We conclude that the use of games in design education can provide an excellent basis for discussing practical and ethical reasoning during the process of design.

Keywords Games · Design process · Collaborative design · Responsibility

Design Education and Ethics

Introduction

The teaching of ethics in technical subject areas has now matured into an established body of theory and case study. Since Davis [1] described how ethics could be integrated throughout the technical curriculum at IIT many universities have followed suit. The TU Delft has, in the past 10 years, followed a broadly similar approach [2] by introducing compulsory ethics courses into almost all subject areas. At the TU Delft, while most subjects have adopted ethics as a natural

P. Lloyd (✉)

Design and Innovation, The Open University, Milton Keynes MK7 6AA, UK
e-mail: p.lloyd@open.ac.uk

I. van de Poel

Department of Philosophy, Faculty of Technology, Policy, and Management, TU Delft,
P.O. Box 5015, 2600 GA Delft, The Netherlands

part of what has to be taught, particularly with the increasing professionalization of courses, there have been several exceptions, notably industrial design engineering and architecture.

This may seem odd given that it is precisely these subjects that, at a technical university, concern themselves most directly with the practical wellbeing of people. Industrial design engineers design objects and systems, and architects design spaces and structures, that aim to make peoples lives qualitatively better. One might think this an intrinsically ethical thing to do. This may, of course, go some way to explaining why these subjects have resisted including compulsory modules on ethics, the thinking being that there is no need if ethics is somehow intrinsic to the process of design.¹ Whitbeck [6] has noted the close relationship between ‘real-world’ ethical problems and design problems suggesting that the process of design—the core of design education—can be used to resolve ethical problems, particularly those ethical problems that involve allocation of scarce resource. Dorst and Royakkers [7] have built on this approach showing how ethical problems can be resolved using ‘designerly’ thinking. It might just be that designers and architects have always realised the ethical nature of their professions.

Whitbeck [6] rightly concludes that ethicists, in seeking to understand the process of design, have much to learn from designers about the practical resolution of ethical problems, but this tends to assume a rather narrow, consequential focus of what we would normally consider to be ethics. While many technical subjects are largely theoretical and lecture-based, industrial design and architecture continue to be studio-based, where design is primarily learnt through tutoring, practice, and reflection. Intuition plays a role here, and indeed is often actively encouraged as students develop the capacity to make informed judgements during the process of design. One could argue that there is an ethical dimension entwined with practical judgement here, and that may well be the case, but if so it is an ethical dimension that remains largely undiscussed; a ‘felt’ ethics, rather than an ‘analytical’ or reasoned ethics.

While the argument that there is less of a need to teach ethics to industrial design engineers or architects holds some weight, there are some important countervailing

¹ An argument for why the process of design might be intrinsically ethical derives from Dewey’s concepts of imagination and deliberation. The imagination, Dewey argues, is essential to the process of deliberation in that it allows the consequences of alternative situations to be considered: Casebeer [3] notes: “the capacity to imagine is crucial for moral reasoning on Dewey’s account.” In Dewey’s *Human Nature and Conduct* [4] he explains that: ‘Deliberation is an experiment in finding out what the various lines of possible action are really like. It is an experiment in making various combinations of selected elements of habits and impulses, to see what our resultant action would be like if it were entered upon. But the trial is in imagination, not in overt fact. The experiment is carried on by tentative rehearsals in thought which do not affect physical facts outside the body. Thought runs ahead and foresees outcomes, and thereby avoids having to wait the instruction of actual failure and disaster. An act overly tried out is irrevocable, its consequences cannot be blotted out. An act tried out in imagination is not final or fatal. It is retrievable.” (pp. 132–133)

This has obvious parallels with the process of design, a process that very deliberately weighs up the value of alternative solutions, and is largely dependent on the designer’s ability to imagine. More recently Johnson [5] has extended the argument that imagination is core to ethical decision-making with evidence from cognitive science. He concludes that activities that help to develop imagination—and one might infer designing as one of these activities—are valuable in this respect.

considerations. First, while intuitive ethical judgements might be sound to the designer concerned, in increasingly complex and inter-disciplinary design processes these judgments need to be made explicit and discussible. Second, the narrow consequential assumption about design necessarily making people's lives better needs to be challenged. Third, although products and buildings might once have been considered independent entities, they are now intrinsic to wider cultural and ethical contexts and debates, particularly for example in the areas sustainability and consumption. Designers need to be at the centre of these debates, clear about what they are doing and why they are doing it.

Practical Action Combined with Theoretical Reflection

The practical nature of design education presents a challenge to the teaching of ethics. Schön [8], looking at design education, identified a blueprint for solving many real-world problem situations where 'practical' knowledge is required to reach a solution. Schön terms this knowledge *knowing-in-action*; knowing how to re-frame a problem situation to allow movement towards a solution. This 'practical' knowledge, in Schön's analysis, differs from the theoretical knowledge derived from what he pejoratively calls technical rationality, the body of scientific theory that divides means from ends, and that is conventionally taught at technical universities. Schön felt that students were lacking essential practical knowledge, identifying the design process as a model through which this kind of knowledge could be acquired.

There are parallels here with Whitbeck's [6] idea of the design process being a model for the resolution of 'real world' ethical problems. Both Whitbeck and Schön imply that a theoretical understanding of practical or ethical situations is not enough. What is needed is some sort of practical knowledge—a 'knowhow'—in dealing with situations. It is interesting here to consider the field of engineering, which has generally been considered successful in teaching ethics from a mainly theoretical and hypothetical point of view.² Students are taught ethical theory, given ethical guidelines and codes, and discuss ethical cases, but they do this all at one step removed from any practice-based ethical situation. They understand in theory what ethics is and how it might operate, but not in practice. Instead the impression given is that ethics is a sub-discipline—a checklist even—to be consulted when relevant, but not generally an integral part of the engineering design process. Holt [10] argues that practical precedents are the basis for good judgement in design, ethical and otherwise. With little exposure to meaningful practice an engineer's ability to develop good ethical judgment will inevitably be attenuated. Arguably the practical workplace issues involving engineers are exactly the same as those involving designers and business managers, which would imply that they too would benefit from the acquisition of this 'practical knowledge'. This is, of course, not a

² Winner [9] has questioned the success of this way of teaching ethics, arguing that it both ignores the way in which ethics can be found in normal day to day experience, and that it tacitly accepts existing structures of power which, from an ethical point of view, would be better examined. Whereas the teaching of ethics could be used as a means of questioning much existing engineering practice, Winner seems to suggest, it is in fact rather hypothetical, even anodyne.

new argument. Aristotle was well aware of the strong link between practical and ethical knowledge: “practical wisdom is the capacity to know what is good for human beings; thus, it includes excellent deliberation.” (quoted in Casebeer [3])

The point here is not to claim that practical knowledge about ethics should replace theoretical knowledge but that, where possible, the two approaches should be combined. Practical and theoretical knowledge should enhance one another by allowing practical action to be linked with theoretical reflection. This paper suggests that one possible way in which this can be done is through the use of games. We first describe how games can be used to acquire practical knowledge before then going on to describe the development and playing of a game to teach the ethical concept of responsibility. The paper concludes that games can be an extremely useful way of both giving students ‘real’ experience about the (ethical) complexities of the design process and creating discussions about ethical issues based on that experience.

Use of Games and Simulations in Educational Contexts

What Games Can Do

The use of games and simulations in educational contexts, although perennially popular with students, have not in general been taken up by faculty, possibly because of the frivolous association that game-playing suggests. Yet games, in creating rule-bound, often social and competitive environments, provide a way of getting students to use their practical knowledge in managing indeterminate, open-ended situations. Games can provide a way of developing skills such as negotiation, rhetoric, strategy formulation, presentation of evidence and theory, as well as providing direct experience for later reflection. The ostensible subject matter of a game—the theory upon which a game might rest—is only part of the story when play begins. This structure of rules and behaviour, of normative and descriptive, applies equally to ‘real-world’ situations.

Games can illustrate the messiness and contingent nature of real-life processes [11] and engage what Kuhn [12] refers to as ‘the whole person’—intuitive emotional responses as well as clearly thought out lines of reasoning.

Business Games

The use of games in education has been most extensive in the area of business where multi-variable, computerised models of product and market environments have provided accurate simulations of, for example, a product launch and marketing. By manipulating key variables students learn that they have to react quickly, making strategic decisions in a changing environment. One often sees students poring over the latest figures generated by the computer, and trying to formulate a coherent strategy for the next phase of the game. Kuhn [12] summarises: “class-room games accomplish both engagement and involvement in ways that are exceedingly helpful to business students” engaging both emotion and

reason. Haywood et al. [13] cite psychological evidence that “students learn and retain more of what they learn when they actively participate in problems”.

Recent literature has detailed the development of specifically ethical business games. Bos et al. [14] describe the development of a game involving ethical decision-making in preparing takeover bids, together with an analysis of how successful students were in balancing the trade-off between profitability and social responsibility. Gibson [15] looks at how two person games such as the prisoner’s dilemma can be used to teach ethical concepts. Kuhn [12] describes a simulation of the space shuttle *Challenger* disaster based on the same information and time-frame that was available to the original decision-makers. Haywood et al. [13], in the field of accountancy, detail the development of an ‘ethics bingo game’ based around the idea of students justifying and defending an ethical point of view to win squares on a game-board.

Although there is a general consensus that games are both engaging for students and can provide considerable learning in negotiating practical situations Reall et al. [16] are cautionary. In a study of 127 business students they found that moral reasoning was attenuated during competitive game play when compared to non-game moral reasoning, suggesting that participants may have assimilated the rules of game-play as the acceptable boundaries of conduct rather than thinking in the more general terms of benefit and harm. Against this, however, many games reported in the literature [12–15] find that the real learning benefit of games comes from a full discussion of what happened during game play. A game allows certain issues, suppressed in many educational situations, to become discussible. Moral attenuation could well be one of these issues.

Design Games

If games are a well developed mode of teaching in business-focused faculties, they have been little used in design education. The main research looking at how games could be used in design and design education has come from researchers at MIT. Habraken and Gross [17] described a series of abstract games that “provide an environment for a group of players, acting with individual goals and a shared program, to make and transform complex configurations, free of functional requirements”. Schön [18] devised something he called *The Silent Game* as a way of exploring how intention is communicated and elaborated during the design process. Players were required to communicate their intentions solely through the construction of a design artefact, each player building on what they thought the previous player’s intention might be. A discussion of what was intended, what was understood as the intention, and the reasons for the (frequent) difference then follows. Perhaps the most well developed of the MIT games is Buccionelli’s [19] *Delta Design* illustrating his theory of object worlds [20], the idea that different participants in a design process remain locked within perceptual worlds related to their sub-discipline. In *Delta Design* players form a multi-disciplinary group of designers that work together in designing and constructing a building suitable for, and attractive to, the inhabitants of a fictional planet.

These design games differ from the business games identified in the previous section in that they deliberately try to embody, explore, or convey theories about the nature of designing, concentrating on the construction of an artefact as the central feature of the game. Rather than having an explicitly rule-bound environment, with perhaps quite a simple message, the idea is that something is uncovered or learned during the process of design. Indeed design theory has been used in the development of commercially successful games. The computer game *The Sims*—a game with serious ethical import—in which a player has to look after the explicit needs of a number of characters, is based on the ‘pattern language’ design theory of Christopher Alexander [21]. This perhaps relates to the earlier point about design being about making people’s lives qualitatively better. In *The Sims* people are literally kept happy by design, a consequentialist view of the designer’s role.

In summary, although a number of design games exist, there have been none that specifically consider the ethical aspects of designing. The business ethics games, on the other hand, although providing a good illustration of how ethical considerations are woven in to practical decision-making about, for example, corporate strategy, don’t really address the ethical issues that arise during *design* activity. Again we return to the process of design, the process of thinking through alternatives in working towards a solution. This was something that we took account of in producing a design game to teach ethics.

The Development of a Design Game to Teach the Concept of Responsibility

The Course Context

The development of a design game to teach ethics took place against the context of a new course for industrial design engineers and architects at the TU Delft. In this course, rather than try to teach ethics as a distinct subject, we tried to focus on a range of existing subjects in design education from an ethical point of view. The idea was to keep the ethical focus very much at the everyday experience of products and spaces—something that students are used to talking about—as well as any cases coming up in the media as the course progressed.

The subjects we chose to focus on in a course reader [22] were:

- Design process—how the act of designing might also be considered an ethical act;
- Interaction and the form of use—how products and spaces shape our behaviour;
- Sustainability—looking at the arguments for and against sustainable design;
- Responsibility—how far the individual is responsible for work that is done for clients or within organisations;
- Marketing—how design can be used to seduce people into consuming things they don’t necessarily need.

The development of the ethical design game took place in the area of the course on responsibility, arguably the most important concept currently taught in courses

on engineering ethics, and largely taught by considering case studies of engineering disasters such as the Ford Pinto, the Space Shuttle Challenger, or the Zeebrugge Ferry Disaster.

However useful case-study analyses may be for educational purposes they remain ‘after the fact’ and a long way removed from the average engineering design student’s experience. One could even argue that the average engineering designer would never face such an apparently clear-cut ethical choice situation. In the chronologically ‘neat’ way that evidence is presented, a case-study analysis can also give the impression that, with all the evidence laid out, making a decision on an ethical basis can be relatively easy. We would like to suggest that the actual ethical problem is located, not so much in a choice situation, but in the messy reality of the design process, in the ‘smaller’ ethical decisions that the process of design throws up and that results from the conflicting requirements that make a claim on individual designers [23]. By cleaning up this messy reality case study analysis can remove the very element of uncertainty that characterises unfolding ethical situations.

Delta Design

Although there are business games that illustrate the idea of responsibility [14] what was missing was an explicit focus on the process of design, of the messiness of developing an artifact where different stakeholders have conflicting requirements. For this reason we chose to take an existing design game, that of Bucciarelli [19]—*Delta Design*—and add an ethical element to the play.

Delta Design takes place on a two-dimensional fictional planet—DeltaP—with distinct physical and social laws. Figure 1 shows a typical game-play situation.

The idea of the game is that a multi-disciplinary group of designers (structural engineers, thermal engineers, project managers, and architects) work together in designing and constructing a building suitable for, and attractive to, the inhabitants of



Fig. 1 Students playing the Delta Design game. The triangles represent the basic building blocks of the game, details of individual roles are given in handouts

DeltaP. For each discipline there is detailed information about how to make both detailed calculations and ‘rule-of-thumb’ judgements. Deadlines and budgets can also be imposed to more closely simulate a real design process. The object of the game is to understand how multi-disciplinary design works and as such there are no winners or losers. Game play consists in coming up with a building form of red (hot) and blue (cold) triangles meeting all formal, thermal, structural, and project management requirements. Each discipline involved in the game has a brief detailing the requirements and needs of the clients. As is often the case these often conflict; using a lot of red (hot) blocks, for example, although meeting the client’s need for comfort, might mean cost overruns for the project manager. There is also one master variable that can be set that makes meeting the requirements easier or harder.

Adding an Explicit Ethical Dimension to *Delta Design*

The original game contains implicit ethical choices because the participants have to trade off different conflicting requirements, some of which are related to moral values; such trade-offs themselves imply ethically-laden decisions [24, 25]. The original game, for example, includes requirements with respect to the strength and robustness of the construction, which are motivated by the moral value of ‘safety’. Other requirements refer to temperature and are motivated by concern for the comfort and well-being of the inhabitants of the building. Still other requirements refer to the beauty of the structure and are motivated by the value of aesthetics and, again, the well-being of the inhabitants of DeltaP. All these requirements conflict, so that the participants in the game have to make decisions about the relative importance of, for example, safety versus aesthetics. This ethical dimension, however, usually, remains implicit during the playing of the game. Therefore, we added an explicit ethical scenario to trigger discussion about the ethical dimensions of the game.

In Bucciarelli’s original game there is one unpredictable constraint for the designers to consider and that is a ‘gravity wave’ whereby the gravitational axis of the planet shifts orthogonally for a period of time and then returns to normal. The structure designed by the team is required to withstand a gravity wave although the magnitude of such a wave is unpredictable with no discernable historical pattern. The waves only occur very rarely however.

In the ethical version of the game students complete the game as normal, but are then given a further scenario. They are told that some years after the construction of their design there has been a gravity wave that has destroyed their building and caused a loss of life. They are also told that theirs was one of only a few buildings affected and that questions are being asked about the quality of the design. They are asked to consider their design process, in the light of these events, to see what might have been overlooked and make a short statement to the Deltan press. They are also told that the facts about the gravity wave are still hazy and that a critical public would like to see resignations from the designers originally involved in the project.

This (admittedly slightly Kafkaesque) scenario forces the designers to consider the decisions they made during the design process and consider what was discussed, agreed and calculated. Were any ethical issues considered during the design process?

How were they resolved? And most importantly is there any evidence to back the designers up? There is an additional game-playing element here in that if teams can clearly find who is responsible, and that person is prepared to take responsibility, then the other members of the team can be declared winners, though this aspect of the game is purely to provoke a searching analysis of who might be responsible and why.

Game Play

Overview

The course has now been given on three separate occasions over the last 3 years, with the game being played by seven groups of between 4 and 6 students (both industrial design engineers and architects). For purposes of familiarisation students receive game instructions several days before the game itself is played. The game takes around 3 hours after which there is a short review. The ethical scenario is then handed out. Students are given several days to reflect on and discuss the scenario together before composing a statement to the Deltan press.

The Playing Process

Game play typically starts off relatively slowly, with tentative moves and solution proposals made by the students who have prepared well for the exercise while those who haven't try to make sense of their roles. To some degree each person is given too much information to process in the time period of the game and has to make a judgment about whether to trust the 'rule-of-thumb' guidelines given, or whether to try and understand the detailed calculation methods.

Generally it is the architect who starts, by proposing a certain structure. The architect, and sometimes the project engineer, tend to take the lead in the design process, while the structural and thermal engineers work on assessing the effects of the design in relation to the requirements for which they have responsibility in the design brief, i.e. the strength and robustness of the structure, and temperature. In some games we observed that only the architect, or only the architect and project engineer, moved the triangles that made up the design. The structural and thermal engineers made calculations and suggestions but did not physically change the design. Typically then, a certain division of labor and responsibility develops during the game, which the participants take for granted.

As with all design tasks there is a great deal of learning that goes on during the design process. As the game play reaches its conclusion the players gain more confidence in making analyses and predictions about the effects that changes to the structure will have on their own discipline areas. Notably only minimal time is spent 'educating' other players about the nature of the other disciplines. Rather, it would seem that players try to get a rough idea of the boundary conditions that any particular discipline puts on the play. Indeed, it is striking how quickly the players develop an ability, or think that they have developed an ability, to intuitively judge combinations of components or even complete solutions.

The structure usually changes very little in the latter part of the game. Instead small changes are made as the deadline approaches. As proper calculation for the structure takes some time this would seem a rather limiting strategy, making several assumptions about the nature of the structure, for example that small alterations won't alter the nature of the whole. What happens less frequently is that an initial solution will be constructed for purposes of learning—finding out through a particular example what the requirements mean—before being removed from the board and a 'proper' solution constructed. This could be characterized as more of a design approach, learning about the problem by proposing solutions [26].

At several points during the game the subject of gravity waves usually comes up. Even though these are suggested as worse-case scenarios they are often only superficially considered, as little information is given about their magnitude. The structural engineer will usually have a go at making allowance for gravity wave strikes.

The following conversation, transcribed from one of the games that was videoed, explicitly considers the ethical consequences involving the temperature of a structure that has been proposed:

Project Manager:	Is it really 1325 [units]?
Architect:	No it's 1425 [units]
Thermal Engineer:	Another red triangle would be nice ...
Architect:	[after pause] No, shall we keep it like it is?
Thermal Engineer:	Yes, but people will die, it will be nice and blue but
All:	[laughter]
Project Manager:	And it's 50 euros over budget
Architect:	50 euros! Come on that's nothing for an architect
Thermal Engineer:	Well, you can have something that looks beautiful
Architect:	will people really die?
Thermal Engineer:	Yes! it's a catastrophic problem if it gets too warm
Structural Engineer:	[pause] Let's just make it less beautiful then ...
Architect:	Can we perhaps make something a bit smaller?

This segment of conversation nicely illustrates the way that ethics appears in the design process. Not as a process of explicit calculation, but as a process of intuitive judgement involving a negotiation about how to make certain ethically relevant trade-offs. The ethical cost of people dying is caught up both in the cost of the structure, and the way it looks. In terms of thinking about responsibility this is an interesting example to consider: nothing is written down, no one person assumes responsibility, there is no calculation made to prove the point, instead a number of suggestions are made as to how people dying can be avoided.

At the end of game play there is always interest in what kind of structure other groups have arrived at and groups are asked to make a short presentation of their design process, explaining how they have reached their end result. After this the ethical scenario described earlier is given to them; they are told that after a gravity

wave has struck, their building has been destroyed with loss of life and that the press is blaming them. They are then told that they will have to prepare a response to this scenario in the form of a press release.

The Ethical Scenario

Initial reactions on being presented with this scenario tend to be vociferous, with students pointing the finger at other group members and trying to apportion blame. After some time, the realisation slowly dawns that they will have to meet as a group to review their design process and discuss what course of action to take.

Blame often turns first to the structural engineer. After all, it was part of the structural engineer's role description to calculate the strength of the construction. Given the apparent failure of the structure, he or she would seem most responsible. However, other modes of failure soon become apparent. The structure might also have failed because of a meltdown, after becoming too hot, which points at the thermal engineer. What often happens is that the structural and thermal engineer do not calculate the final tolerances of the structure because some last-minute changes were made to the design. But who is to blame for this? Perhaps the project manager should have organized the process so that the structural and thermal engineer had more time to make calculations? Moreover, the various requirements were conflicting, so that some compromising of the strength and temperature might have been unavoidable, or did the architect and project engineer push too hard for their requirements, neglecting other important concerns? As mentioned earlier, the architect, sometimes in combination with project manager, often assumes leadership in the design process which seems to place a special responsibility on his or her shoulders. It quickly becomes clear to the students that distributing responsibility is by no means clear-cut.

In the feedback exercise some days later the groups read a 'press statement' to describe their reaction to the disaster with the other groups forming a critical press, asking questions about the design process following the statement. The following is an example of a press statement (translated from the Dutch):

The whole team is responsible for this disaster. We are thus resigning as a team. The optimal structural solution could not be verified because of the conflicting interests of team members and the assignment itself. The eventual design was a compromise between all design criteria. Our thoughts are with the families of the victims at this time.

The discussion that is generated from the press statements is the most valuable, because it is a theoretical discussion based on practical experience. A number of important issues usually come up. A good example is the idea of 'remorse', closely related to the concept of responsibility. Although the ethical scenario calls for resignations from the designers, this does not mean that quick resignations will necessarily be acceptable. For simply to assume responsibility and resign could then be seen as an easy way of avoiding talking publicly about a poorly documented design process (for example). Clearly that is not what is wanted from a public demanding explanations. There must be a proper process of investigation together with a fitting response. Responsibility shouldn't be assumed too quickly.

What is also interesting is the balance between the privately experienced process of design, and the public explanation of that process, which focuses directly on the most important factor; that of people having died. This is an important realization for the students who, during the process of design and not knowing what the final outcome would be, had balanced the possibility of deaths along with other many other factors (and one could easily imagine the press focusing in on another single factor, the ‘ugliness’ of a structure for example). It is the conflict that is set up between practical, first-hand experience, on the one hand, and the explanation of that experience, on the other that provides a strong point of reflection for the exercise.

The Concept of Responsibility

The ethical scenario is designed to trigger discussion about responsibility and to teach students something about the concept, and especially how it is worked out in practice. In theoretical discussions about responsibility, a number of relevant distinctions are made.³ One is that between retrospective responsibility, also sometimes called passive responsibility, and prospective responsibility, also called active responsibility. Both are relevant in the DeltaP game. During the discussion of the ethical scenario and in preparing a press statement, students mainly focus on passive responsibility. Conditions that are usually mentioned in the literature to hold someone passively responsible include:

- the existence of a causal connection between someone acting and the disaster—for example, would the disaster have occurred if the design had been different?
- the transgression of a norm—the structural engineer failing to make a calculation for example
- blameworthiness—for example could the participants in the design process have known that the structure would fail and could they have acted differently? [27].

All these conditions usually come to the fore in the students’ discussion and in the press statement, and if not the teachers can draw attention to them. The passive responsibility after the disaster has occurred is, however, also related to the active responsibility students assume, or could assume, during the game. For example, as we have indicated, the architect often assumes an active responsibility for changing, or refusing to change, the design of the structure, which also increases his or her passive responsibility afterwards, as most students recognize in their discussions.

Another relevant distinction is that between role responsibility and moral responsibility. Role responsibility is defined by, and confined to the role description that students receive at the start of the game.⁴ Moral responsibility is a broader responsibility for the effects of one’s actions and may extend beyond the role of the participants. Some students are really quite shocked by the disaster that happens

³ See for example Bovens [27], Whitbeck [6], Harris et al. [28].

⁴ What we refer to as role responsibility is akin to what Whitbeck [6] calls *official responsibility* and what Harris et al. [28] call ‘the minimalist view of responsibility’. Both stress that moral responsibility extends beyond official or minimalist responsibility.

after game play ends, especially by the fact that so many Deltans have died due to the failure of a structure that they have designed. They immediately and intuitively assume moral responsibility for the disaster, partly because it is *their* design. This is one of the reasons why it is so important for students to play the game and experience the ‘feeling’ of responsibility. In the discussion afterwards, they have to come to grips with the possible gap between the moral responsibility they feel and the role responsibility they have according to their role descriptions. One of the things that this teaches them is that it is not enough to only assume role responsibility but that it might also be required, both as a designer and as part of a design team, to actively assume a broader moral responsibility.

A final important aspect of responsibility that is taught by the game is the collective character of responsibility and the importance of distributing responsibility. Often, in organizational settings, responsibility distributions are incomplete in the sense that for certain issues no one is clearly responsible. This phenomenon is sometimes referred to as the ‘problem of many hands’ [5, 29]. Something similar often happens during the playing of the game. Who, for example, is responsible if it is decided to compromise safety by making the structure a little bit less robust so that other considerations, like costs or aesthetics can be better met? Such decisions are often made collectively and implicitly, so that responsibility is difficult to allocate. There is no simple solution to this problem, but it might teach students that it is important to think about how to distribute responsibilities beforehand, when they set up a design team, instead of only later when a disaster has occurred.

Discussion

The strength of the ethically cast Delta Design exercise is that it allows students to reflect on their own experience rather than on the experience of others. In this way the link between cause and effect is reinforced, and students can understand that ethical situations are the result of (normal) practical action and not ‘special’—in the sense that case studies promote a feeling that the case is exceptional. For this to work, the activity of the game must be a reasonably convincing approximation of ‘design reality’ and this was indeed the initial purpose of the game. The game also includes a whole design process, from requirements to product, which demands a wide range of decision-making (this contrasts with the approach of focusing primarily on the ‘big’ decisions prevalent in case-study analyses).

The role-play of the game shows another important aspect of ethical concepts in general and responsibility in particular. This is the idea that ethics must in some way be ‘felt’. Learning about the concept of responsibility in theory is a lot different from feeling responsible for something happening. With the Delta Design exercise we have tried to use the latter approach, while in the lectures we emphasise the former. Alternating between theory and practice is highly suitable for teaching ethics in design, we feel.

It is interesting to contrast the ethics displayed by students while playing the game with those expressed when the game is finished and the ethical scenario presented. Although the game is played within the context of a course on ethics, we

are often surprised at how little explicit discussion about ethics there is during the game. The gravity wave scenario *is* explicitly considered by most groups, but there is no sense that the purpose of the game might turn on the ethical seriousness of this scenario becoming true. This, we would argue, is the situation in most design processes. There is usually a vague sense of what *could* happen without an explicit discussion of how such a possible situation might be avoided. There is also no discussion about how bad it would be for such a situation to occur.

There is a sense of designers riding their luck here with possibly the idea that external factors usually cause ethical scenarios, not factors resulting from the process of design. This contrasts greatly with the discussion after the scenario is presented, which is explicitly ethical, and often quite sophisticated. Designers clearly have the ability to talk in ethical terms, they just don't seem to do it during the average design process.

In summary the Delta Design game contrives an ethical situation but it does so in a manner as realistic as possible. It was mentioned before that the exercise is somewhat Kafkaesque—the accused looking for the reasons for their guilt—but it has proved effective in communicating and illustrating the ethical concept of responsibility. The close coupling of practical action with theoretical discussion demanded by the game has proved highly suitable for a course on design ethics.

Conclusions

We have described how, through using a collaborative design game, it is possible to give students 'practical' experience of ethical decision-making in the process of design. We have done this because we think it is important that students 'feel' ethical concepts as much as 'know' about them; that students understand in practice what it 'feels' like to be responsible, for example, as well as having a theoretical understanding of what responsibility, as an ethical concept, is. The implication here is that 'feeling' an ethical concept is part of 'knowing' about that concept. There is clearly a balance to be struck here, but we conclude that in teaching ethics to engineers, and indeed other kinds of designers, there needs to be a greater emphasis on the acquisition and discussion of practical knowledge. Games, as we have shown, are one way in which this can be achieved.

References

1. Davis, M. (1993). Ethics across the curriculum. *Teaching Philosophy*, 16, 205–235.
2. van de Poel, I., Zaandvoort, H., & Brunsen, M. (2001). Ethics and engineering courses at Delft University of Technology: Contents, educational setup and experiences. *Science and Engineering Ethics*, 7, 267–282.
3. Casebeer, W. D. (2003). *Natural ethical facts: Evolution, connectionism, and moral cognition*. Bradford Books.
4. Dewey, J. (1922). *Human nature and conduct*. Prometheus Books.
5. Johnson, M. (2003). *Moral imagination: Implications of the cognitive sciences for ethics*. University of Chicago Press.
6. Whitbeck, C. (1998). *Ethics in engineering practice and research*. Cambridge University Press.

7. Dorst, K., & Royakkers, L. (2006). The design analogy: A model for moral problem solving. *Design Studies*, 27, 633–656.
8. Schön, D. (1983). *The reflective practitioner*. Temple Smith.
9. Winner, L. (1991). Engineering ethics and political imagination in Johnson, D. In *Ethical Issues in Engineering*. Prentice Hall.
10. Holt, J. (1997). The designer's judgment. *Design Studies*, 18, 113–123.
11. Vaughan, D. (1996). *The challenger launch decision*. University of Chicago Press.
12. Kuhn, J. (1998). Emotion as well as reason: Getting students beyond "interpersonal accountability". *Journal of Business Ethics*, 17, 295–308.
13. Haywood, M. E., McMullen, D. A., & Wygal, D. E. (2004). Using games to enhance student understanding of professional and ethical responsibilities. *Issues in Accounting Education*, 19, 85–99.
14. Bos, N. D., Shami, N. S., & Naab, S. (2006). A globalization simulation to teach corporate social responsibility: Design features and analysis of student reasoning. *Simulation and Gaming*, 37, 56–72.
15. Gibson, K. (2003). Games students play: Incorporating the prisoner's dilemma in teaching business ethics. *Journal of Business Ethics*, 48, 53–64.
16. Reall, M. J., Bailey, J. J., & Stoll, S. K. (1998). Moral reasoning "on hold" during a competitive game. *Journal of Business Ethics*, 17, 295–308.
17. Habraken, N. J., & Gross, M. D. (1988). Concept design games. *Design Studies*, 9, 150–164.
18. Schön, D. A. (1992). Teaching and learning as a design transaction. In *Research in Design Thinking*. Delft University Press.
19. Bucciarelli, L. L. (1999). Design delta design: Seeing/seeing as. In *Design thinking research symposium 4*, Boston, 23–25 April.
20. Bucciarelli, L. L. (1994). *Designing engineers*. MIT Press.
21. Alexander, C., Ishikawa, S., & Silverstein, M. (1978). *A pattern language*. Oxford University Press.
22. Lloyd, P., & van de Poel, I. (2004). *Ethics for industrial design engineers: ID5471 course reader*. TU Delft.
23. Lloyd, P., & Busby, J. (2003). 'Things that went well—no serious injuries or deaths': Ethical reasoning in a normal engineering design process. *Science and Engineering Ethics*, 9, 503–516.
24. van de Poel, I. (2001). Investigating ethical issues in engineering design. *Science and Engineering Ethics*, 7, 429–446.
25. van Gorp, A., & van de Poel, I. (2001). Ethical considerations in engineering design processes. *IEEE Technology and Society Magazine*, 20, 15–22.
26. Lloyd, P., & Scott, P. (1994). Discovering the design problem. *Design Studies*, 15, 125–140.
27. Bovens, M. (1998). *The quest for responsibility. Accountability and citizenship in complex organizations*. Cambridge University Press.
28. Harris, C. E., Pritchard, M. S., & Rabins, M. J. (2000). *Engineering ethics: Concepts and cases*. Wadsworth.
29. Thompson, D. F. (1980). Moral responsibility and public officials. *American Political Science Review*, 74, 905–916.

Copyright of *Science & Engineering Ethics* is the property of Springer Science & Business Media B.V. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.