EQUALITY OF INTELLIGENCE AND REPRESENTATION-FORMS. EXAMPLES OF TWO COOPERATIVE ENGINEERINGS TO SOCIAL ISSUES

IGUALDAD DE INTELIGENCIA Y FORMAS-REPRESENTACIONES. EJEMPLOS DE DOS INGENIERÍAS COOPERATIVAS VINCULADOS A CUESTIONES SOCIALES

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Resumen

La desigualdad de género, y la desigualdad vinculada a la discapacidad, son cuestiones sociales (Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura [Unesco], 2016). Desde la perspectiva de la emancipación, nos parece que estas cuestiones requieren pensar en la igualdad desde un punto de vista pragmático, desde el momento en que se pone en práctica. Así, para que la igualdad sea una realidad, es necesario desarrollar dispositivos. Este artículo pretende mostrar lo que, en "ingeniería cooperativa", favorece la consecución de la igualdad. En particular, tratamos de poner de relieve el vínculo existente entre igualdad, ingeniería cooperativa y "formas-representaciones". Este artículo se basa en dos ejemplos empíricos. El primer ejemplo procede de una ingeniería cooperativa en el primer grado. Formada por tres profesores de primaria y un investigador, el objetivo de esta investigación cooperativa era desarrollar una situación en la que los alumnos de primer curso de primaria co-escribieran un cuento en parejas de niños y niñas. Intenta responder a la siguiente pregunta: ¿En qué medida el encuentro con el arte de la co-escritura, a través de las formas-representaciones de esta práctica, contribuye a una igualdad de inteligencia de la co-escritura, favoreciendo la creación colectiva de un dispositivo que concrete la igualdad de niñas y niños en la escritura de un cuento? El segundo ejemplo se basa en la ingeniería cooperativa en la que participan profesionales de una ESAT y un investigador. En él se analiza cómo este colectivo inventó una nueva "solución-objeto" (Baxandall, 1985, 1991), la alfombrilla de desmontaje, que es una forma-representación particular de desmontar y volver a montar una cuchilla de cortacésped. Intenta responder a la siguiente pregunta: ¿Cómo pone en práctica el proceso de invención colectiva de un objeto concreto la inteligencia igualitaria en el equipo de ingeniería?.

Palabras clave: Igualdad; ingeniería cooperativa; formas-representaciones; género; discapacidad.

Abstract

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Inequalities of gender and disability are social issues (United Nations for Education, Science and Culture Organization [Unesco], 2016). From an emancipatory perspective, we think that these issues require us to think about equality from a pragmatic point of view, from the moment we put it into practice. In this way, in order for equality to become a reality, it is necessary to develop mechanisms. This article aims to show what favors the achievement of equality in «cooperative engineering ». In particular, we tried to highlight the link between equality, cooperative engineering and « forms-representations », with basis in two empirical examples: cooperative engineering in a primary school, formed by three teachers and a researcher; and cooperative engineering in an ESAT, with the participation of professionals from the ESAT and a researcher.

Keywords: Equality; Cooperative engineering; forms-representations; gender; disability.

1. Introduction

Gender inequalities and disabilities-related inequalities are societal issues (Unesco, 2016). From an emancipatory perspective, we believe that these issues require a pragmatic approach to equality, starting from its implementation. Without proactive measures, equality does not establish itself naturally. On the contrary, for equality to become a reality, we need to develop specific mechanisms. Within the framework of the joint action theory in didactics (Sensevy, 2011, 2020), this article aims to demonstrate what, within cooperative engineering (Joffredo-Lebrun, Morellato, Sensevy & Quilio, 2018; Perraud, 2022; Sensevy, 2011; Sensevy & Bloor, 2020), promotes the realization of equality. We particularly wish to highlight the link between equality, cooperative engineering, and the "representation-forms" (Collectif Didactique pour Enseigner [CDpE], 2024) which we will define. According to us, the realization of the equality of intelligences (Rancière, 2012) takes shape in and through the representation-forms that are at the heart of cooperative engineering. This is what we propose to explore in this article. To this end, and after presenting elements of our theoretical framework, we rely on two empirical examples.

The first example comes from cooperative engineering at the primary level. Comprising three primary school teachers and a researcher, this cooperative research aimed to develop a situation in which first-year primary students would co-write a story in mixed-gender pairs. From this example, we will attempt to explore to what extent the encounter with a cultural practice (here, writing and co-writing), through the representation-forms that materialize and symbolize it, contributes partly to an equality of intelligences that fosters what we call a *collective creation of common intelligence.*

The second example (Perraud, 2019, 2022) is based on cooperative engineering involving professionals from a work assistance and support establishment (ESAT)[1] in the medico-social sector and a researcher. From its description, we analyze how, by investigating a problem from the practice of a horticulture workshop (the removal and replacement of a lawnmower blade), this collective invented an unprecedented "object-solution" (Baxandall, 1985, 1991), a disassembly mat. This shared work represents both the means of investigation (the problem the collective is investigating) and the end of this investigation (the collective solution). More specifically, the disassembly mat, as a representation-form, is a concrete expression of the mode of thinking of this cooperative engineering. We will attempt to answer the question: How does the process of collectively inventing a concrete object implement equal intelligence within the engineering team? Finally, to conclude, we will combine these examples to discuss the

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[1] " Établissement et service d'aide par le travail – ESAT ".

process of serendipity leading to the invention of common work in cooperative efforts aimed at equality.

2. Theoretical elements

Within the framework of the Joint Action Theory in Didactics (JATD), we understand didactics in the anthropological sense of the term, as the study of knowledge practices. Specifically, we are interested in the transactions between individuals, transactions that take the form of knowledge. Sometimes this knowledge is conveyed within the context of a didactic relationship between a teacher and a student, where the relationship is asymmetrical from a knowledge perspective. Other times, this knowledge is shared within the context of an epistemic cooperative relationship, among individuals in a collective that takes the form of cooperative engineering. These individuals are always practical connoisseurs of a certain practice, meaning they have worked extensively on this practice and are "therefore able to accomplish it with skill, whether they are gardeners, musicians, mathematicians, carpenters, dancers, plumbers, teachers, etc." (CDpE, 2024, p. 432,). The challenge of this transaction is to strive towards an epistemic balance. Thus, in the work of a common problem, individuals share knowledge. Their action is guided by the principles of cooperative engineering, notably the symmetry target search, i.e., the production of assertions (data useful for problem-solving) and the consideration of these assertions to strive for an equal relationship to the problem. This is referred to as a *dialectic of knowledge/unknowledge* (Perraud, 2022).

In this article, we focus on the role of representation-forms, particularly in engineering work. By representation-forms, we mean: "a system of signs that allow teaching, learning, investigating, and imitating, particularly imitating the culture of a practice that is thus represented" (CDpE, 2024, p.475).

We refer to "forms" because these include all material and symbolic forms (verbal, graphic, gestural) from which an individual's or a collective's work starts and develops. We associate "representations" with "forms" to signify that these forms have a specific function: to represent ways of acting. We create things (instruments, tools, forms, objects, gestures, words...) to better think about our actions, to act better, and to practice better. It seems self-evident. Nevertheless, these representation-forms are, for us, an important object of focus because they seem to be at the heart of human action, of the intelligence of a practice.

In our research, knowledge is considered inseparable from concrete practice; it is a *practice of knowledge*. According to this view, "knowledge implies and is constructed within practices. More precisely, knowledge is seen as what enables action in a situation, what confers the power to act. Conversely, we can say that any power to act is knowledge" (CDpE, 2024, p. 479).

3. Two Empirical Examples from Cooperative Engineerings

3.1. 1 Example 1: Gender Equality through the Practice of Co-Writing

3.1.1. Introduction

The first case study stems from a cooperative engineering effort involving a researcher and three primary school teachers. This research focuses on the realization of gender equality through writing situations of an invented story in the first grade. The aim of this case study is to demonstrate two points. Firstly, how the encounter of the engineering collective with an *art of doing* (Certeau, 1984), the art of co-writing, contributes to equality among the members of the engineering team and to a collective creation of intelligence. Secondly, to what extent representation-forms facilitate this.

This research originates from gender inequalities, considered from the perspective of realizing equality. The goal of this research ist "the practice of equality" (Rancière, 1991,p. XIX).The premise is as follows: gender equality arises from mutual recognition of the equal abilities of women and men.Moreover, this recognition is fostered by mutual recognition between girls and boys of their equal abilities, from an early age and continuously. Applied to the school context, this implies implementing, from the earliest grades, situations where girls and boys experience their equal abilities through a practice of knowledge. Here, the targeted practice is writing, in the sense of writing an invented story, and the grade level concerns the first grade of primary school. Furthermore, for girls and boys to experience their equal writing abilities, the collective chooses to have them write together. Therefore, for the research team members, the task is to develop and implement co-writing situations in mixed-gender pairs. Moreover, for mutual recognition of their equipotence to emerge, the common work must be valid. Valid, on the one hand, in the sense that girls and boys write symmetrically, meaning each contributes their share, just as the other does, to writing the story. Valid, on the other hand, in the sense that the story told is coherent and exhibits a certain literary quality.

3.1.2. Methodology

Cooperative engineering and the study film constitute the research methodology implemented here. The researcher records writing situations in each classroom with the support of two cameras. One camera captures the classroom in a wide shot, while the other focuses on a specific pair in close-up. Both cameras record continuously. The selection of pairs is partly based on obtained image rights permissions, the students' proficiency level in reading and writing, and their placement within the classroom. The recorded situations are then transcribed. During the engineering team meetings, the analysis of co-writing situations

emerges from the intersection of filmed and transcribed data, teachers' testimonies of their
experiences, and the students' productions.

3.1.3. Results

We present one of the results of the research based on the analysis of an episode extracted
from the engineering.

3.1.3.1. Episode Context

The following episode occurs at a crisis point in the engineering process. To put it briefly: at this
stage, two co-writing devices have already been developed by the research team and
implemented iteratively. However, these devices proved to be unsatisfactory (Gerin, 2020).
Particularly in the second device, one boy in a pair tells the girl, "It's only your ideas, and
besides, they don't fit together!" (Gerin, 2020, p. 181). In fact, this device does not facilitate the
creation of a valid common work. Valid in the sense that each girl and boy contribute equally,
and valid also in the sense that the story invented by the students is not always coherent.
Consequently, mutual recognition between girls and boys of their equal writing abilities cannot
occur: if the work is not valid, what capacities would recognition be based on? Moreover, the
implementation of this second device, which included more instructions in an equally
constrained time frame, proved to be particularly stressful for the teachers. As one of the
teachers stated, "this avalanche of instructions was quite distressing" (Gerin, 2020, p. 196). At
the end of this second device, the collective finds itself at a moment of indecision, even
discouragement. It is also a moment of great uncertainty. The researcher fears that these
successive failures may prematurely end the collective research.

However, the following excerpts attempt to explain how, when facing a deadlock, the
encounter with the art of co-writing will allow the collective to pivot. This pivot leads to a form
of collective ingenuity and a shift towards taking primary control of the investigation, not only
by the researcher but also by the teachers. This encounter of the collective with the art of co-
writing occurs in two stages: an interview with a co-author and the viewing of a documentary
film about two comic book authors.

3.1.3.2. Encounter with the Art of Co-Writing

First Encounter with the Art of Co-Writing: Interview with a Co-author

The collective's interview with a co-author, Isabelle Amonou, aims to learn about her approach
to co-writing a detective novel with another author, Michel Dréan (Amonou & Dréan, 2018).
Several elements emerge from the collective's interview with the co-author, particularly the

necessity, for co-writing in symmetry, of a common foundation at the outset, materialized in a
document shared between co-authors. Specifically, this is evident in a document presented by
the co-writer, which outlines the synopsis of the story, the main characters, and the different
chapters to be written. Below is an excerpt from the document presenting the chapters. In the
original document, the chapters appear in color (chapter 11 in blue, chapter 12 in black,
chapter 13 in green) to immediately show the distribution of chapters among co-authors (one
chapter per author, one character per chapter).

Table 1

Extract from the "Common Starting Base" document, shared among co-authors

Chapter 11
The employee fled to France where he pursued studies (chemistry, for example: credible in Rennes). He believes he will find old friends there, but they have all left the city. The killer is on his trail (we need to know how he tracked him: phone, …?). This is where he encounters the former soldier and gives him the key before being killed.
Chapter 12
The killer realizes he has been deceived and that the key has changed hands. He finds the drunken soldier and injures him in a fight, but the soldier manages to escape with the key. The killer retrieves the combat dagger that the soldier had kept.
Chapter 13
The soldier, wounded in the arm, takes refuge at the home of the social worker, who reluctantly lets him in due to his condition. She treats his wound and provides him with shelter.

The co-writer comments on the document:

> "When you write together, you have to start on the same page because otherwise,
> when each person writes separately, you risk having two different, incompatible stories.
> (...) So at the beginning, we had this [holds up a double-sided A4 page]: the simplified
> synopsis, summaries of the first chapters based on important characters, a two-line
> description of each character. Here [points to the document showing a list of chapter
> summaries to be written, including an excerpt presented above. The font color varies
> for each chapter between blue, black, and green], the chapters in blue were for me, the
> black ones chosen by Michel, and the green ones were chapters not yet assigned".

The author also specifies a certain temporality of co-writing: a daily, ritualized, and sufficiently
long time, alternating between solitary writing sessions and communal time. Shortly after this

interview, one of the teachers involved in the research suggests to the collective to watch a
documentary film.

Second Encounter with the Art of Co-Writing: Watching a Documentary Film on Two Comic
Book Co-authors

The documentary film (Loisel & Tripp, 2009) showcases two comic book authors, Régis Loisel
and Jean-Louis Tripp, collaborating on their series "Magasin général." It represents the
collective's second encounter with the art of co-writing. The teacher is familiar with Loisel's
work as she has read all the albums. The suggestion to share this resource with the engineering
team comes from the fact that, according to the teacher, elements of this documentary
resonate with what the co-author mentioned about her art of co-writing. Each member of the
engineering team watches the film, and then the collective gathers to develop an improved
third co-writing device for girls and boys. Here is an excerpt from the exchanges among the
collective members regarding the documentary film.

> **Member 1:** "[The authors say that they have] 'a backbone', [quoting Loisel from the
> film] 'We have point A, point B... but we don't know how...', it's [quoting again] 'the
> detours to get from point A to point B' that motivated them the most, [quoting again]
> 'because we discover a path we hadn't planned, things we didn't suspect ourselves'."

> **Member 2:** That's right. And I think we should keep that.

This short excerpt partially reveals the following.

Firstly, when reading these anonymized verbatims, it can be challenging to determine with
certainty whether the researcher or the teachers are speaking. In reality, the first verbatim is
from one of the teachers involved in the research, while the second is from the researcher.
Secondly, although very brief, this exchange brings out essential elements of the art of co-
writing, particularly the starting framework and the unknown. It proves to be relatively rich in
knowledge. However, this epistemic density is acknowledged as follows:

- by the teacher who proposed this resource to the collective, following up on the
  elements about co-writing from the interview with the co-author.
- by the teacher who, based on quotes from the film that he systematically noted in a
  notebook, precisely reports on what the comic book co-authors say about their way
  of co-writing.
- by the researcher who suggests keeping the idea raised by the teacher, relying
  himself on what the comic book authors say about their practice.

In other words, epistemic responsibilities are assumed by both the researcher and the teachers. The encounter with the art of co-writing fosters this equality in taking primary ownership of the investigation into the art of co-writing. However, we believe that this equal taking of primary ownership of the investigation does not happen by "magic", but due to the representation-forms that symbolize and/or materialize the practice of co-writing:

- The representation of co-writing taking shape through the interview with the co-author, particularly materialized by the "Common Starting Base" document she presents to the research members.

- The representation of co-writing taking shape through the documentary film on comic book co-authors, which leads to another representation of comic book co-writing materialized by the notes of the teacher in his notebook.

These representation-forms constitute a common background for the way of crafting a story written by two individuals. And it is from this background that the research members will each become capable of thinking about student co-writing in a different way than usual. In doing so, the researcher and teachers will jointly become capable of assuming a didactic responsibility as well. This equal didactic responsibility materializes in the collective invention of a particular co-writing device, called the *Draft Strip* (Gerin, 2020). This device, in a way, translates for CP students the way writers and co-writers make themselves capable of co-writing a valid work. In fact, the draft strip contains within it a common starting framework, the distribution of one chapter per author, one character per chapter invented by one for the girl, and for the other by the boy. The writing on the draft paper occurs particularly from slips inspired by Marcel Proust's manuscripts. The writing time is daily and takes shape in an alternation between solitary writing time and exchanges between co-authors. Like for the writers, writing is also part of a time of uncertainty: one does not know what the student will write.

In other words, in a certain way, the encounter with a cultural practice (here that of writing and co-writing) through the representation-forms that materialize it, symbolizes it, participates, within the collective, in an equality of intelligence of this practice. This equality of intelligence of the practice that the members of the collective deal with fosters a collective creation of intelligence (materialized here by the Draft Strip). Conversely, the collective creation of common intelligence confirms the equality of intelligence among the members of the engineering in relation to the practice to which they pay attention.

3.2. Example 2. Disassembly mat in an ESAT

3.2.1. Introduction

A work assistance and support establishment (ESAT) is a medico-social institution that has a particularity compared to all other establishments in this sector. It has a dual mission: to support people with disabilities, referred to as "workers," while enabling them to engage in professional activities producing services or goods for clients, carried out in workshop settings. The workers are supervised by workshop supervisors, specialists in the respective trades.

3.2.2. Methodology

Our qualitative methodology is both ethnographic and clinical (Leutenegger, 2000; Sensevy, 1999). It is characterized by an experimental framework based on the conception, realization, observation, and analysis of teaching-learning situations, involving both researchers and practitioners, and attached to cooperative engineering.

Over three years, a collective of professionals from the ESAT (including workshop supervisors in restoration and horticulture) and a researcher gradually developed and studied a device based on two complementary and interconnected actions: 12 cooperative engineering meetings recorded and transcribed; teaching-learning situations co-constructed by professionals and the researcher, implemented in ESAT workshops with the workers, and documented in a field journal.

3.2.3. Results

3.2.3.1. Context of the Episode

In this article, we focus our discussion on the green spaces workshop[2] (GS), where production involves a service for clients, consisting of maintaining green spaces, called worksites (exclusively mowing and pruning).

During the eleventh cooperative engineering meeting (CEM 11), the collective reflects on the following problem: how to enable the workers in the green spaces workshop to properly removal and replacement lawn mower blades? Indeed, in the green spaces workshop, it is common to sharpen or even replace lawn mower blades.

3.2.3.2. An Inquiry Based on the Practice Problem "Replacement and removal Lawn Mower Blades"

Continuing with the solutions considered during previous cooperative engineering meetings (CEM 1 to CEM 10), the collective begins to ponder the drafting of an instructional text,

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[2] In this establishment, there are 6 green space teams, indicated by the acronyms GS1 to GS6. There is also a main green space supervisor noted MGSS.

intended for both literate and non-literate workers, to enable them to change lawn mower blades. In this new phase of the inquiry, the collective questions the formulation of action statements to properly guide the workers in the practice of "blades removal/replacement".

Through the exchanges, the practical non-connoisseurs (in horticulture) gradually grasp that one of the recurrent difficulties in the action of removal/replacement a lawn mower blade is the risk of losing the parts. Furthermore, based on Oscar's insistence (GS3), they perceive that having a "clean floor" is a necessity.

In line with this, the researcher, a practical non-connoisseur, makes a suggestion. The previous day, she was in Paris with workers who wanted to buy souvenir keychains at the foot of the Eiffel Tower. It turned out that the vendors used large white sheets on which they displayed the souvenirs. She then thought that this arrangement prevented the keychains from being lost or soiled. Therefore, she proposes: "So, you don't use sheets?" The green spaces workshop supervisors joke: "White sheets?!!! Yes! But they get dirty!!"

This idea is deemed eccentric by the green spaces supervisors: a sheet to prevent parts from being lost. Then, the restoration supervisor, Fanny, who was also in Paris, intervenes: "Yeah! Their method for gathering equipment was pretty good!!" The researcher's eccentric idea resonates with Fanny, who also saw these sheets. For her, the sheet is practical, as it would prevent the equipment (the keychains) from being lost. Carine (greenhouse supervisor) then connects the Parisian vendor's sheets, the issue from CEM 11, and her green spaces colleague's jokes. She returns to the green spaces supervisor's comment about grass being dirty for the sheets. Patrick (GS5) offers an explanation: the keychain vendors use the sheets so they can leave quickly if the police arrive. He sees no connection with the removal/replacement problem.

The inquiry continues. The researcher asks the green spaces supervisors if they ever perform this action in the grass. Jean-Philippe (MGSS) confirms they rarely do so, only when there are no other options. Carine (greenhouse) immediately perceives the risk of losing parts in such situations, a sentiment echoed by Oscar (GS3).

What solution could prevent parts from being lost during removal blade?

As the researcher revisits the idea of a clean floor, Fanny, the restoration workshop supervisor, suggests using a tarp instead of a sheet, as it is more suitable for the terrain conditions, even though its typical use is to cover objects rather than place them on it. However, this "eccentric idea" of using a sheet or tarp does not gain consensus. It is dismissed. The collective thus continues drafting action statements for the instructional text "removal and replacement a

lawn mower blade." Throughout this writing process, increasingly significant forays into inventing another solution occur.

The diagram below (Figure 1) illustrates how, starting from the eccentric idea of a sheet, the collective actors consider a succession of object-solutions (gray rectangles), uncovering various problems (depicted in the ellipses of the illustration below).

Figure 1

Sequence of Ideas to Solve the removal/replacement Problem in the Collective Inquiry Work of the Eleventh Meeting CEM 11
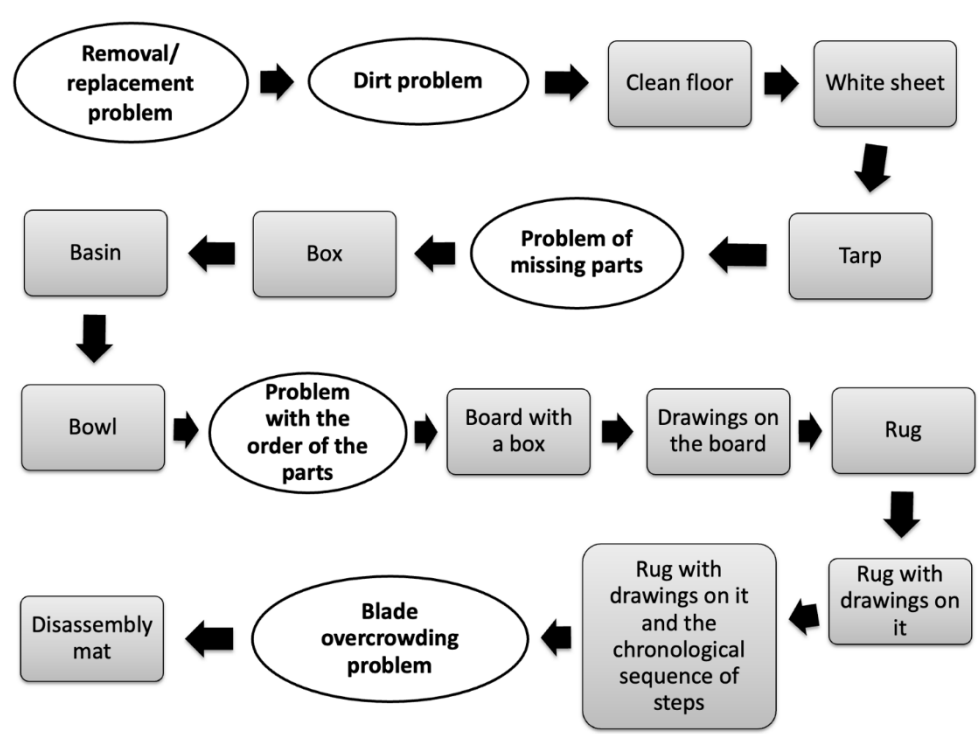

We have seen that the dirt problem led to the eccentric idea of the sheet. Subsequently, new proposals were put forward by one or another member of the collective. Each time, these solutions raised new problems, forcing the collective to refine its proposal. Little by little, the collective arrived at what it termed a "disassembly mat" which considers all the characteristics of the solutions envisaged throughout the collective investigation work. A sketch was then drawn by the researcher, based on the indications of the actors adhering to the idea. Seeing the idea materialize in the form of a drawing, even the most skeptical were eventually convinced. Jean-Philippe (MPEV) suggested that, even if the blade is long and extends beyond the space of the mat, the blade is "sufficiently thin" to be placed on it. The green space

supervisors then indicated the names of the parts and their place in the sequence of
removal/replacement.

Below, we present the sketch of the mat (Figure 2).

Figure 2

Sketch made during CEM 11 of the mat
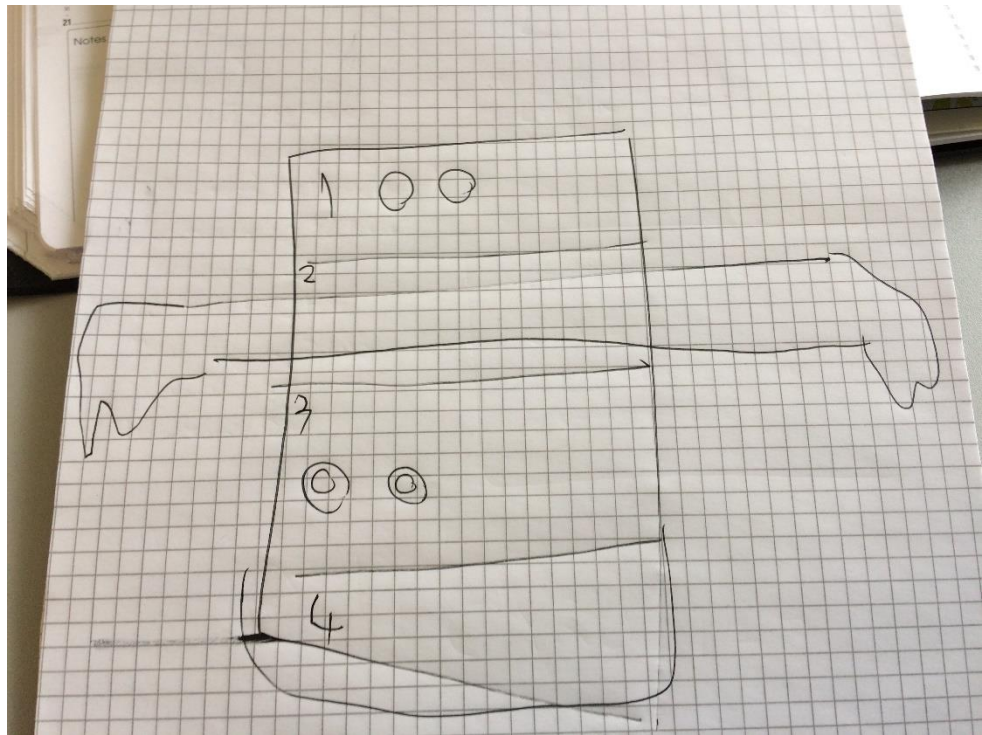
Note. Four steps are distinguished from top to bottom. Silhouettes of parts are drawn (step 1, outlines of screws,
step 3, outlines of bolts) as well as the blade laid across at step 2. Nothing is drawn for step 4.

Shortly after this meeting, Patrick, a supervisor from the green spaces, manufactures and tests
a prototype with his team (Figure 3, below). During an impromptu exchange with the
researcher, Patrick and his team explain that certain constraints led them to slightly modify
what had been envisaged during the IC11 meeting.

Figure 3

The disassembly mat as it is presented in the green spaces workshop
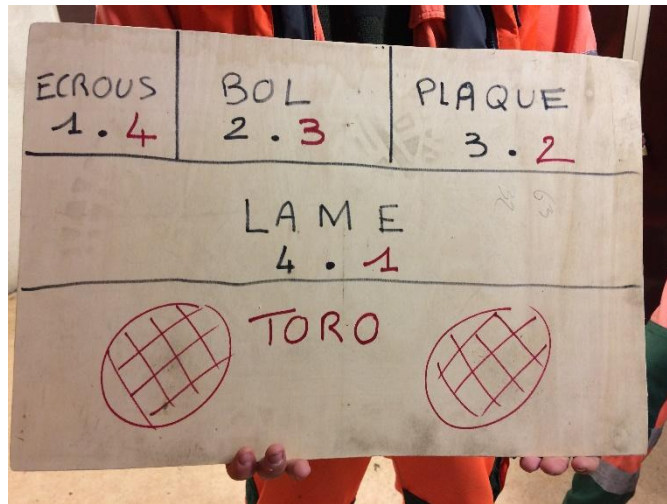
Above are five spaces in which the names of the parts (nuts, bowl, plate, blade) and the brand
of the lawnmower (Toro) are listed. Numbers indicate the order in which the parts should be
removed during removal (numbers from 1 to 4, in black), and then during replacement
(numbers from 1 to 4, in red). Finally, the circular shapes (on either side of the word "Toro")
indicate the placement of the knees, as the action is performed kneeling, facing the
lawnmower placed on its side.

3.2.3.3. Analysis: How does the process of collectively inventing a concrete object implement equal intelligences within the engineering team?

During this cooperative engineering meeting, the green space supervisors are the practical
experts, unlike the others (including the researcher and Fanny) who are the practical non-
connoisseurs. The disassembly mat is one of the collective works of thought of the ESAT. It is
also one of the material representations of the thinking style of this collective. As a *object-
solution* (Baxandall, 1991), this disassembly mat crystallizes the intentional system of this
cooperative engineering, while also serving as the concrete anchoring point of the collective
investigative work. This collective work is a system of representations in a dynamic dialectic
(the work in progress) and static (the completed work). In other words, the disassembly mat
represents both the means of inquiry (what the collective investigates) and the end of this
inquiry (the collective solution). Beyond this dual characteristic of the collective work, we
highlight some salient aspects in this example.

Firstly, all members of the collective engage in the search for solutions. They take on the task of
the practical problem. Initially, in continuation of previous solutions (the instructive text), they

develop strategies according to the techniques in use (skills), materialized once again by the writing of action statements. They consider a first response, an action statement: "working on a clean floor." However, as the collective is about to retain this action statement, the researcher suggests a second solution to this cleanliness problem. She uses here a heuristic, a strategy presenting an unprecedented form, or even, at this moment of engineering activity, a whimsical form, a sheet.

Secondly, as the collective reflects on the problem, each member draws upon a shared background (common available strategies) constructed over the course of the collective inquiry work. They have become practical experts in cooperative engineering. They understand that one of the necessities of collective inquiry work is to produce assertions and to appropriate the assertions of others (the principle of symmetry). However, each also relies on their own background. Every way of seeing the situation, every description of practice, produced and submitted to the collective, becomes a support for engineering dialogue, with the collective goal of constructing a *common way of seeing* (Wittgenstein, 2004), enabling the envisioning of a common system of strategies. This common system of strategies then generates a shared semiosis, a common way of deciphering reality.

In our example, the concept of a clean floor represents, for Oscar, a problematic state of the world (the floor must remain clean, otherwise we lose the pieces), meaning that "this state of the world contains saliences, affordances, human or non-human, which encourage the production of certain strategies" (Sensevy, 2011). This problem prompts the researcher to propose the following strategy: a sheet to protect the dismantled pieces from dirt on the floor. The researcher thus introduces something new into the common strategic system related to the problem. However, the green space professionals, drawing on their practical knowledge, do not see this solution as adequate. Furthermore, based on their practical knowledge, this strategy presents them with another problematic state of the world, leading to other meanings: a sheet is dirty; therefore, it cannot protect the pieces from dirt. The collective does not share the same state of the world. They cannot grasp the same meanings, have the same way of seeing, and therefore cannot agree on the strategy of using a sheet to solve the problem of dirt.

Thirdly, Fanny, the restaurant supervisor, not a practical expert in green spaces, also sees the sheet as a solution to the problem of dirt that solves another problem raised in the discussions, that of losing pieces. She shares with the researcher a common background that allows her to grasp the seemingly absurd idea of the sheet. Fanny sees in the "sheet" state of the world a sign (to gather the material) prompting her to consider a strategy (use the sheet to avoid losing pieces). This sign is common to two states of the world:

- the problematic state of the world (protecting the lawnmower from dirt) as seen by the researcher. This state of the world leads her to produce the strategy "a sheet to protect the floor";

- the problematic state of the world (a sheet is dirty) as seen by the green space supervisors. This state of the world leads them to reject the researcher's strategy.

A dynamic, descriptive, and semiotic process emerges here, in which agents suggest different solutions, based on their own background. Different perceptions of the same situation lead to *engineering controversies* (Perraud, 2022). At the same time, engaged in cooperative engineering, they develop a common background as a common strategy system. The movement generated by engineering controversies is the result of a subtle and reciprocal relationship between a semiotic process, a way of seeing itself the fruit of a style of thinking. From this movement emerges the collective invention of the disassembly mat as a solution to the removal/replacement problem. This disassembly mat has allowed for better action in the workshop. Furthermore, two years later, this disassembly mat is still in use and a second disassembly mat has been made (Perraud, 2022). However, on the one hand, this solution was not anticipated by the collective, and on the other hand, it arises from an absurd idea: it proves to be surprising. In this regard, it seems to us that cooperative engineering "fosters the process of serendipity," that is, the ability to "pay attention to a surprising phenomenon and imagine a relevant interpretation" (Catellin & Loty, 2013, p. 34). Also, we consider cooperative engineering as a "serendipitous institution" (Perraud, 2022).

4. Conclusion

In the first example, the collective finds itself at a moment of crisis. After two unsatisfactory writing devices, the teachers and the researcher face a deadlock: what to do, how to proceed with the collective work? The detour through the practice of co-writers, collectively encountered, ultimately leads to the invention, by the collective, of an improved original and unexpected writing device: the Draft Strip. In the second example, the collective is not strictly speaking in a crisis moment, however, each proposal for a removal/replacement device for lawnmower blades raises a number of issues. What to do, how to find a solution capable of addressing all the problems, when the techniques in use (skills) appear insufficient? By a detour via the mention of the street vending practice encountered the day before in Paris by three members of the collective, the researcher suggests the sheet. Initially, this proposal is perceived as a far-fetched idea by the practical horticulture experts. However, the detour through this practice ultimately leads to the invention, by the collective, of an appropriate original and unexpected removal/replacement device: the disassembly mat.

In a way, each of these events could be seen as a *serendipitous accident* (Ross, 2023) in that they are "firmly embedded in action [with the fact that] the results of the actions are both noticed and generate surprise" (Ross, 2023, p. 10). In this sense, cooperative engineering is a *serendipitous institution* (Perraud, 2022). Linked to serendipity, it seems to us that the temporality in which cooperative engineering is inscribed, that of "the time of attention", constitutes a decisive element of the serendipitous process, and in particular that of the time of attention to what insists from the point of view of practice.

In both cases, paying attention, individually and collectively, to what insists, for oneself, for another, for others, proves essential to better think about the devices. Yet becoming capable of this type of attention to what insists is not obvious. Thus, for Stengers (2023):

> "we are relentlessly exhorted to learn how to extract - that is, abstract - ourselves from what we hold on to, and holds on to us. This capacity to render negligible what our abstractions are abstracted from is the yardstick by which we are measured. It is the meaning of apparatuses that separate us from what we know in order to inculcate with docility, with respect for rules defining what we have the right to know." (Stengers, 2023, p. 26)

It seems to us that representation-forms contribute to the collective's ability to inscribe itself in this time of attention to what matters. This is probably partly because representation-forms, in representing practices of culture, open up the possibility of a "time of detour". Contrary to the idea that one must immediately find the right answer, the time of detour allows, at a certain moment, to look elsewhere, from another place, to think "beside", to find what one does not yet know one is looking for. Moving away from the immediacy of the direct path, to take the time for detour, appears here more effective for the collective creation of common intelligence. Probably partly due to a form of agency of representation-forms. In this respect, we agree with Ross (2023): "I am aware of the controversy that can lie in endowing inanimate objects with agency but choose here to use this term to indicate their active involvement in human cognitive processes" (Ross, 2023, p.9). In a way representation-forms act in that they provoke the collective attention to a practice. Now members of a collective no longer think alone, but with what the representation-forms say about this practice. Taking the time to jointly pay attention to what representation-forms say implies suspending the time of immediacy. In doing so, it seems to us that representation-forms anchor cooperative engineering in a form of "slow science" (Stengers, 2011).

> "Needless to say slow does not mean leither. The choice of the expression slow sciences makes this initiative part of the slow motions, the best known of this is slow food: resisting fast bad quality and ready to eat food, and the system that produces it. Slow

science is about a quality of research that is also its relevant for today's issues."
(Stengers, 2011).

In a sense, collectively slowing down, through the detour offered by representation-forms, participates in the collective creation of common intelligence materialized here by the invention of improved devices: the Draft Strip, the disassembly mat. It is a matter of considering collective action "beside" the "acceleration" [that characterizes] our modernity (Rosa, 2010). For Rosa (2010), "Crucial is the idea that acceleration in the end leads to monstrous forms of alienation from time and space, from things and actions - and from self and others"[For Dewey], the creation of knowledge is a social and situated process in which new beliefs arise as a result of individuals' transactions with others and their environment (Sullivan, 2021)" (Wieczorek, 2023, p.360). In this regard, representation-forms, insofar as they facilitate the collective attention of the group to cultural practices, appear to us to constitute these moments of suspension of this time of alienation, for a collective creation of common intelligence.

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