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A Designerly Exploration into an Ideal All-Terrain Vehicle

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Light, Local, Repairable: A Designerly Exploration into an Ideal All-Terrain Vehicle

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Abstract: The article presents a brief visual overview of the educational experiment at the Arctic Design School, Russia, that was a design-driven foresight on micro-scale mobility in the geographical periphery of Russia. The overview includes two student projects of developing locally appropriate ATVs for remote, roadless areas with severe climate conditions. During the work, students studied publicly available sources on "vernacular design," also known as—since Soviet times—the movement of DIY-enthusiasts of garage-making and tinkering. They also explored the very meaning of the environmental and social context of making/using/repairing locally appropriate vehicles by drawing from firsthand observations of relevant practices on site. Then, reflecting critically on the concept of an ideal ATV, they worked on its aesthetic component by employing the method of artistic composition. As a result, students came up with design proposals built upon existing vehicles invented by local makers from selected regions of Russia. The article concludes with calling up design professionals to contribute to the development of ethically and aesthetically appropriate solutions that could be integrated into local knowledge networks while respecting existing actors and patterns of use.

Keywords: Design Education, Local Knowledge, Transport Design, Artistic Composition

Introduction

Today, user innovation is an important phenomenon that describes the process of competing and even displacing producers in many areas (Baldwin and von Hippel 2011). However, for almost three decades of research on user innovation the focus has been on economically developed settings, while its applicability in other economies still remains mostly unexplored. In this article, we shift the focus to a specific context, i.e., the settings of Soviet and post-Soviet Russia geographically limited to sparsely populated and peripherally located areas of the Russian North, where user-innovation activities used to and still play a role of a compensatory mechanism for non-market economic relations (Fursov, Thurner, and Nefedova 2017). Mostly overlooked by designers and planners, the locally emerged grassroots principles of self-sufficiency and people's creative response to the environmental challenges constituted the subject matter of an educational experiment at the Arctic Design School, Ural State University of Architecture and Art, Russia. A special nine-week course, "An Ideal ATV for Extreme Environment," was developed for first-year MA students who already had a BA degree in industrial design, and its thematic focus was chosen to complement the students' natural interest in the field of transport design.

The article is structured as follows: First, we outline the research context by introducing the phenomenon of the Soviet DIY-movement and reviewing the instrumental framework of the students' projects, namely the method of artistic composition. Second, we elaborate on the process of data collection and the methods employed by describing the educational experiment step-by-step. Third, we illustrate the approach with designs of selected models of home-made

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ATVs. Fourth, we discuss the results with reference to the provided theoretical, historical, and methodological framework. We conclude by outlining potential directions for further research.

Historical Context: Phenomenon of Soviet DIY-Enthusiasts

The Soviet/Russian variation of the DIY-phenomenon is deeply grounded in the wider historical and social context of a so-called "repair society" (Gerasimova and Chuikina 2009). Having reviewed "repair stories" from Soviet Russia, sociologists Ekaterina Gerasimova and Sofya Chuikina conclude that perpetual repairs would typically develop into a creative act, and it used to be (and still is) a key feature of daily life not only in disadvantaged groups but for the majority of people. The main reasons for that include (Gerasimova and Chuikina 2009, 61):

- the persistence of the traditional peasant culture that promoted the preservation and prolonged use of items, transfer of repair skills, and independent production of things;
- the experiences of wars, revolutions, and poverty that taught many people to be frugal and thrifty and adopt natural exchange and barter;
- the Soviet economy with its shortages and low-quality goods that necessitated acquiring repair skills; and finally
- the regulation of consumption by the state as well as propaganda encouraging a certain attitude to the ownership of things that promoted a repair-oriented mind-set (mentality, culture).

Within the all-encompassing DIY-culture, the homemade transport vehicle movement began with the advent of the internal combustion engine (ICE) of small volume and dimensions in the late 1950s and 1960s. These were mainly motorbikes, mopeds, scooters, etc., which did not meet the needs of the non-urban population from areas with mainly impassable roads. The urgent need and untiring desire to solve the practical problem of small-scale personal mobility led to numerous attempts to build a workable off-road vehicle for household needs drawing on existing models, e.g., the motorbikes "Voskhod" or "Izh." In addition to basic skills, these attempts involved an incredible wit, ingenuity, and inventiveness of local makers.

The prior conditions for developing local transport solutions included:

1. Availability of ICEs from motorbikes, scooters, chainsaws, "Zaporozhets" cars, etc. Most often, it was enough to come by a simple motorbike to turn it into an all-weather all-terrain vehicle for personal needs.
2. Availability of materials for making the structural elements of future ATVs, e.g., joints, frames, wheels, etc. The main (almost endless) source of parts was industrial scrap from local landfills.
3. The shared "skillscape," i.e., embedded practical knowledge resulting from the Soviet system of mass secondary/professional education, which enhanced technological literacy and promoted rich handcrafting experiences.
4. Practical knowledge of local complex geographical conditions.

One of the visible results of that "vernacular technological creativity" was increasing small-scale personal mobility within the non-urban communities of the regions under study. Also, people extended their practical knowledge of the landscape, climate, flora, and fauna, as well as that of technology and machinery. These sets of knowledge were polished by time and eventually evolved into the principles of surviving and comfortable living on the land. Thus, local DIY-enthusiasts have to date developed (and continue doing so) a database of "practical innovations" for researchers, engineers and designers who are involved in developing solutions to non-urban mobility problems.

Instrumental Context: Artistic Composition in Transport Design

The basic definition of artistic composition we rely on is the one by Harold Osborne: it implies "the creation of a complex configuration, which is nevertheless apprehensible as a single perceptual unity, a unity of parts or elements related by rhythms, balance, symmetries, etc., at various levels of containment but nonetheless ultimately perceived as a unified whole" (Osborne 1976, 102). Thus, with reference to the artistic composition of a transport vehicle, we mean visual agreement of all of its parts perceived and appreciated by a user. However, as Mitcham (2001) notes, in engineering design the artistic (aesthetic) eye tends to be replaced by technical standards and calculations founded in the technological sciences in response to various constructive challenges: from diminishing friction in a mechanical assembly to energy consumption efficiency, etc.. In the particular case of "makeshift engineering" based on "exercising a kind of frugality in making the most out of available materials" (Latoufis and Tympas 2018, 77), artistic visual elements usually attract significantly less attention of the maker/user compared to engineering solutions and cost-effectiveness.

In contrast to engineers—either professional or amateur—who focus on the very principles of movement that are further be covered with "clothing," (industrial) designers "usually work 'outside inwards,' defining the observable envelope, thus constraining the internal constituents and actions" (Eder 2012, 3).

In this endeavor, while putting extra-emphasis on the artistic/aesthetic qualities of a handmade vehicle, we do not at all mean to undermine the importance of other elements, namely engineering solutions and cost-effectiveness. Instead, we argue that greater attention should be directed toward psychological and emotional adaptation of human beings to their living environment, attainable through the unity of functional, structural, and aesthetic qualities of their material/human-made things. Saying this, we echo Zheleva-Martins (2006) in asserting that means of art and design—if mindfully applied—can foster and support the psychological and emotional aligning with the present and future state of the environment. Notably, a mindful application of the laws of artistic composition results in objects that "best correspond to [their] intended purpose and satisfy accordingly human perception in all its aspects" (Zheleva-Martins 2006, 4).

In relation to the teaching of industrial design, artistic composition provides the opportunity to combine two types of professional attitude distinctively defined by Wassily Kandinsky as virtuosic and compositional (Kandinsky 1979). The first one—virtuosic—refers to external and concrete aspects of form-giving, while the second one—compositional—is oriented to operating implicit and symbolic categories related to the development of context-sensitive solutions. In the case of developing experimental design proposals based on existing handmade ATVs, the purpose of the artistic immersion is to turn the designer into a co-author of the local maker by commenting on and refining the visual appearance of his machine. By following the construction principles and functional features of the original vehicle, designers, we believe, can successfully fit into the complex web of the local needs, existing patterns of use, and environmental limitations.

To come up with experimental proposals, we operationalize artistic composition into a method by:

- transforming the original design into a language and turning it into a "compositional key." Hereinafter "compositional key" will mean a 2D abstract composition with condensed information about the compositional center(s), rhythms, symmetries, etc. in the visual appearance of the vehicle;
- evaluating and (if necessary) refining the compositional key based on the laws, rules and principles of artistic composition, such as: the law of unity, the law of combination and comparability, the law of contrast; the rule of the thematic and

compositional center; the rule of thirds; the Golden Section, etc. (see more in Zheleva-Martins 2006, 4); and

- imposing the refined compositional key back on the object to obtain an updated version of the original vehicle. Here the compositional key serves as a direct entry into the inherent structure/hardware and its representation (Eder 2012).

Data and Methods

The process of data collection was centered on ATV-making activities documented in Soviet DIY-magazines and specialized internet forums. It started with browsing through the entire archive of the magazine "Modelist-Konstruktor"/"Young Modelist-Kostruktor" 1962–2011 (Figure 1), i.e., 567 issues, from which twenty-eight relevant ones (mainly from the period of the late 1970s to the early 1990s) were selected.

Figure 1: Examples of Covers of the "Modelist Konstruktor" Magazine Devoted to Transport Vehicles
Source: Modelist-Konstruktor 1960s-1980s.

For gaining an insight into the present-day situation, we combined the data from the earlier research (Hyysalo and Usenyuk 2015; Usenyuk, Hyysalo, and Whalen 2016) with a random search for the most recent information about homemade ATVs in Google and Yandex (the largest search engine in Russia). As a result, we selected two models: (1) a three-wheeler/two wheels with a front ski; and (2) a four-wheeler with a swivel-joint frame. These models first appeared in the Soviet magazines and then re-appeared almost unchanged twenty to thirty years later on the DIY-forums (see Figures 2 and 3).

Figure 2: Examples of ATVs with Three Wheels/Two Wheels + Front Ski
Source: DIY Forums, Late 1990s–2010s.

Figure 3: Examples of Swivel-joint Frame ATVs
Source: DIY Forums, 2010s

The Educational Experiment Step-by-Step

The students were given an assignment to choose one geographical area and—correspondingly—one locally designed ATV (based on "love at first sight") and then proceed with this set through several stages, as follows:

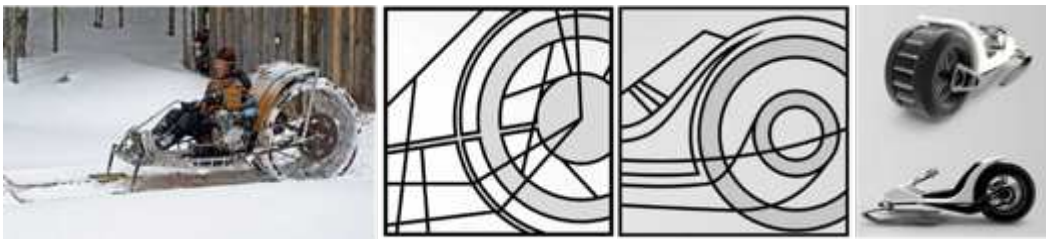
Stage 1: Context Analysis: understanding the local specific user needs and requirements of the environment. The data came from previous studies (Usenyuk 2011; Hyysalo and Usenyuk 2015; Usenyuk, Hyysalo, and Whalen 2016), including ethnographic field trips, remote surveys and experts' reports on local road conditions. At this stage, the collected visual materials were combined into collages or paper installations (Figure 4 and Figure 5, *Stage 1*).

Figure 4: Understanding the Environment: Visual Representation of Local Conditions
Source: Denis Kukanov and Anastasia Sukhoguzova 2018

Stage 2: Artistic Analysis: exposing the artistic composition of the ATV under study and assessing the aesthetic compatibility of design elements. The application of the described method of artistic composition began with creating and further evaluating the visual composition of a selected piece of technology. At this point, all illogical elements and possible inconsistencies between construction parts were revealed (Figure 5, *Stage 2*).

Stage 3: Artistic Transformation: the aesthetic qualities of the original composition are understood and transformed within the framework of social and communicative interactions between users and technology. At this point, through answering the question, "how can I make this composition look 'more attractive,' that is more interactive and visually/emotionally engaging?" the students developed a transformed artistic composition (Figure 5, *Stage 3*).

Stage 4: Distant Co-creation: anticipating the future ATV by addressing distant contexts through the changed/harmonized artistic composition. Initial design proposals were developed to be taken further for user evaluation and iteration (Figure 5, *Stage 4*).



Stage 1 *Stage 2* *Stage 3* *Stage 4*

Figure 5: An Example of Artistic Transformation of a Handmade ATV
Stage 1 is the Original Machine; Stages 2–4 are Compositions and Final Design
Source: Stage 1: Anonymous Maker, Kirov Oblast, 2010s; Stages 2-4: Maria Zotova and Artem Vulfovich 2018

Below we showcase two projects by outlining the geographical and historical contexts and presenting the final design proposals. The original ATVs were selected on the basis of our previous fieldwork and analysis of magazines and internet resources for DIY-enthusiasts.

Case Study 1

The first case is that of a light-weight ATV with a combination of low-pressure wheels and a ski (Figure 2). Its basic features include: Dismantable/portable lightweight well-balanced structure, excellent cross-country ability and maneuverability, especially on soft deep snow.

According to the information in the analyzed magazines, it was invented by Vyacheslav and Vladimir Laukhins from the city of Tula, central Russia, to be used in the extreme and adverse roadless environment of the Polar Urals.

Figure 6: The Model by Laukhin during the Trip in the Polar Urals
Source: Modelist-Konstruktor 1984, Issue 5

The story of its widespread introduction through the "Modelist-Konstruktor" magazine was vividly described by Vadim Shapiro, one of the ATV's dedicated fans, himself an engineer and ATV-maker:

> With the help of the magazine "Modelist-Konstruktor" I found the inventor Laukhin in the city of Tula. So, I went to Tula. Laukhin introduced me to his son Slava, who, by that time, had already made several lightweight snowmobiles. They were weird pterodactyl-like structures made from furniture pipes, with a fore ski, rear-wheel drive, with two tubes from truck wheels. And it turned out that those machines were rather good in riding. Then I thought: 'We should make our trip on these machines!' During that winter we made four vehicles, transported them to Vorkuta and then rode towards Baidaratskaya Guba. (Sud'bin 2003)

The story of that trip—accompanied with detailed drawings of the machine—appeared in two most popular DIY-magazines of that time, "Modelist-Konstruktor" (Chernorotov 1984) and "Tekhnika Molodezhi" (Shapiro 1984). However, any attempts to put this model into mass industrial production failed. The original schematic is still popular among amateur makers and DIY-technology enthusiasts (Figure 2).

As part of the current project, the students chose one of the contemporary versions of the original vehicle and proposed an artistic/designerly update through the method of artistic composition (Figures 7 and 8).

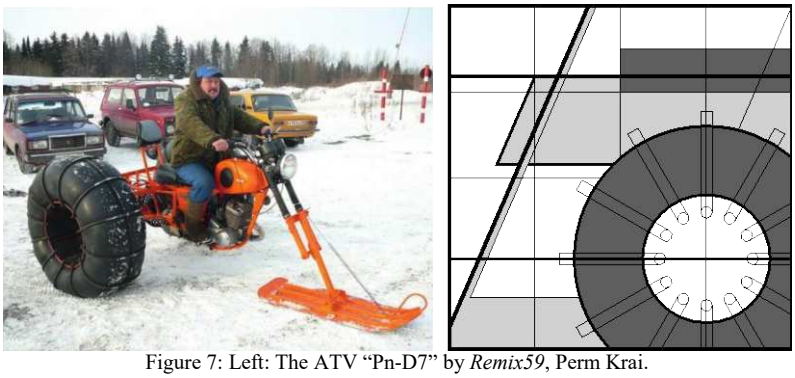


Figure 7: Left: The ATV "Pn-D7" by *Remix59*, Perm Krai.
Right: The Abstract Composition Where the Contrast between the Dark Round Area and Thin Brittle Parts Signify the Visual Disbalance of Mass
Source: pnevmokhod.ru 2009 (Left); Maria Pokataeva 2018 (Right)

Figure 8: Final Presentations
Top: The Contemporary Variation of the Laukhins' Model and the Soviet Motorbike "Voskhod," i.e., the Donor of ATV Construction Parts;
Middle and Bottom: The Refined Artistic Compositions and the Final Design Proposal
Source: pnevmokhod.ru, 2012 (Top); N. Klyusov 2019 (Middle, Bottom)

As a compositional alternative, the designers proposed to replace the massive pneumatic wheels with "Mecanum wheels," which are wheels with series of rollers attached to their circumferences. Coupled with an air-cooled engine from the motorbike "Voskhod," the updated vehicle would be able to traverse cross-country terrains with a speed of up to 80 kph. Also, while looking less solid in terms of the artistic composition, the Mecanum wheels are practically heavier and therefore can prevent the driver from turning over in the event of a sudden collision with an obstacle concealed in the mud or snow. The windshield protects the driver's face and hands from the wind. The steering rack has a shock-absorbing element to absorb bumps while driving through rough terrains. The stylistic solution expresses bionic forms that integrate the vehicle into the northern environment.

Case Study 2

The second case study is a four-wheeled ATV with an articulated/swivel-joint frame, also known as "Vezdekhod Gromova"/ATV made by Alexander Gromov, from the city of Cherepovets (Figure 9). Geographically, the area presents a mostly woody and hilly landscape occupied by coniferous forests (taiga) and swamps, with a moderate continental climate; long, moderately cold winters; and relatively short warm summers. The road network is generally underdeveloped, and many settlements have low-quality transport connections.

Figure 9: The ATV by A. Gromov
Source: Modelist-Konstruktor 1985, Issue 1, Front Cover

This scheme and overall design became and still remain very popular among amateur makers (Figure 3).

The contemporary adaptation of the ATV with a swivel-joint frame chosen for the current project was designed allowing for the requirements of the extreme roadless environment and operational features, for example, a covered/protected cargo space (Figure 10). The result of the artistic and designerly transformation (Figure 11) is an ATV with a structure similar to that of a career vehicle: between two frames having a tubular arc frame, there is a rotary knuckle, which is connected by tie rods to the steering shaft. This structure allows the all-terrain vehicle to fold along the longitudinal axis; thus, it is capable of turning its split body in a horizontal plane. Also, the maximally open body provides for precise control of the vehicle and, therefore, helps avoid miscalculations when crossing virtually impassable places. Finally, the combination of a four-wheel drive, a body with balanced weight distribution that provides for perfect surface traction, and high clearance under all axles, can be expected to ensure agility and ability to navigate hostile terrains.

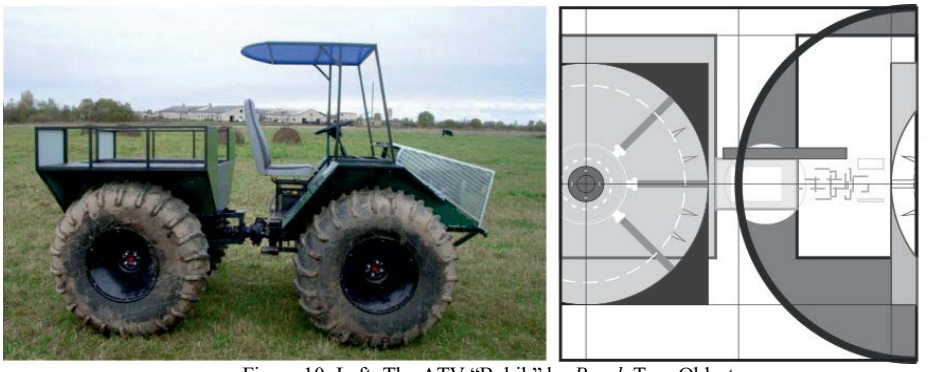


Figure 10: Left: The ATV "Bobik" by *Pavel*, Tver Oblast
Right: The Abstract Composition Emphasizing the Visual Conflict of Squares and Circles
Source: snowmobile.ru, 2011 (Left); Natalia Dedevic 2018 (Right)

Figure 11: Final Presentation
Top Left: The Contemporary Variation of an ATV with a Swing-joint Frame
Middle and Bottom: The Step-by-Step Transformation of the Artistic Composition and the Final Design Proposal
Source: snowmobile.ru 2011 (Top); N. Klyusov 2019 (Middle and Bottom)

At this point, in both cases it was decided to focus on the visual appearance and mobility characteristics in roadless terrains, such as maneuverability, leaving aside the questions of feasibility and manufacturability. Moreover, the latter features were, to some extent, ignored to engage the makers more naturally in the discussion about the pros and cons of the presented solution.

Discussion

By reflecting on the historical (archival) and empirical information about the phenomenon of Soviet and post-Soviet "repair society," particularly among ATV-makers and users, this study puts emphasis on the aesthetics of form. We go beyond the "transcendental"/art-centered concepts of aesthetics and follow Dewey (2005) in arguing that aesthetic experience is not limited to the usual artistic objects but includes all expressions of life. By emphasizing the importance of the aesthetic dimension of human-technology interaction in a peripheral, roadless, climatically severe environment, we believe that it should be given much higher consideration in design/technology research.

Bringing the extended concept of aesthetics to a classroom, we developed an experimental multistep method of artistic composition to rebalance the equation between functional, structural, and aesthetic features in transport technology. The resulting design proposals—based on real handmade vehicles from remote areas of Russia—provide a new understanding of what it means to traverse severe roadless terrains every day and what kind of design can contribute to the psychological and emotional adaptation to those conditions. This understanding—though requiring further experimentation and evidence—is consistent with the naturalistic position of Xenakis and Arnellos, who, in turn, draw on contemporary theories, evidence, and findings from neuroscience (e.g., Cela-Conde et al. 2011; Chatterjee 2011; Rolls 2011), experimental aesthetics (e.g., Locher, Overbeeke, and Wensveen 2010; Locher 2011), and product interaction design (e.g., Crilly, Moultrie, and Clarkson 2009; Hoegg, Alba, and Dahl 2010), considering aesthetic perception "as a normative process that enables agents to enhance their interactions with physical and socio-cultural environments" (Xenakis and Arnellos 2014, 1). Accordingly, the results of the stage of artistic composition transformation lie beyond "positive or negative aesthetic judgments but promote[d] comprehension through individual/personal and social cognition" (Xenakis and Arnellos 2014, 12).

Overall, the proposed method of artistic composition has been demonstrated to be able to facilitate gradual progress in students by linking together the context (geographical, economic, and social), functional content, and artistic/aesthetic appearance. Also, through a detailed exploration of the links between environmental context, user needs, and skills, as embodied in the DIY-vehicles under study, students get access to the unique database of innovative locally appropriate solutions. This method draws on the creative power of design and thus paves the way to "anticipating the future" on the basis of artistic imagination rather than that on technological rationality. In a broader sense, we position this experiment prominently within the scope of design education as follows: by showing *what* and *how* design students can learn from locally developed patterns of making/using/maintaining, utterly different from widely promoted "modernity" or "global" design, we aim to make a contribution to the *situated learning approach* (Lave and Wenger 1991).

Limitations and Further Research

There are, however, several apparent limitations of this study and proposed method. First, the "classroom framework" did not allow us to validate the background assumption about "a psychological and emotional adaptation of the human being to the world" through the means of artistic composition (Zheleva-Martins 2006, 4). We accepted it as it is and built further process thereupon. Second, in its current form, the method is missing the link to the human characteristics of vehicles that can be expressed in a deliberate choice of colors, shapes, etc.

Third, there is insufficient information on the geography of use, including detailed landscape and climatic characteristics of localities, physical travelling distances, and seasonal distribution of activities; nor do we know enough about social and communicative interactions as part of the processes of using/maintaining.

While these limitations require from us not to over-generalize the presented cases to the global phenomenon of makers' movements and user innovations as a whole, there are significant opportunities for research using the proposed method in partnership with other approaches. The research on the "artistic transformation" of user-made technology can proceed to the next level involving synchronous shoulder-to-shoulder collaboration between designers and real makers/users. In our case, the next round—already planned in the form of field trips to selected settlements—will include discussions of design proposals with authors of original machines and then iterative ideation and co-development on site. Although the very idea of such collaboration with local makers is certainly not new, in our case what matters is the convergence of environmental, social, and economic factors. A notable example that inspires us most comes from a geographically different area, Africa, a vast, roadless, and climatically severe region for nurturing a similar kind of "repair society" forced to generate makeshift solutions to meet everyday basic needs (Campbell 2017). A community-centered design approach to local transport problems made a compelling case of "viable and sustainable solutions to challenges surrounding non-motorized rural transport in developing communities" (Design Institute South Africa 2005, 4) developed at the Interdesign 2005 workshop in South Africa (see more in Campbell 2008, 87–96). In this vein, geographical diversity provides valuable insights into the contextual relevance of design activity and, from the educational point of view, certainly enriches discussions on the future of the design profession (Campbell 2008; 2017).

Conclusion

In this article, the findings of a retrospective journey into the history of handmade ATVs built on the social and economic background of the "repair society" are coupled with a sketching exercise concerned with observable possibilities in the forms of new vehicles. In an educational experiment, we explored the idea of studying self-made transport vehicles in their original contexts with links to their makers. In contrast to impersonal industrial products designed and manufactured for use in literally "any" environmental context, the approach implies learning *from* the locals to reveal the principles of context-sensitive mobility and material/human-made adaptation coded in the local artefacts. To this end, we proposed a multistep method of artistic composition with a focus on the following steps: (1) context analysis with the use of observation; (2) artistic analysis to identify critical inconsistencies of the form; (3) 2D artistic transformation with the use of imagination; and (4) distant co-creation with 3D visualization of the transformed vehicle. We believe this method can become the first step towards ethically and aesthetically appropriate solutions integrated into local knowledge networks while respecting existing actors (makers and users) and patterns of use.

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