



SPACE

STRATEGIC PARTNERSHIP
AGENTS OF CHANGE IN EDUCATION

STRATEGIC PARTNERSHIPS: AGENTS OF CHANGE (SPACE) – PEDAGOGICAL FRAMEWORK

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Introduction

The SPACE project strives for innovation by providing future teachers with the necessary know-how in order to implement inter-disciplinary art/science educational approaches within the STEAM framework in European schools.

Write A Science Opera (WASO) is an inter-disciplinary educational environment in which pupils explore science and art simultaneously (Ben-Horin, Chappell, Halstead & Espeland, 2017). WASO activities have been implemented in many countries. The vast majority of WASO activities have been based on scientific themes in the fields of biology, physics, astronomy, and chemistry. The SPACE project aims to *extend* the disciplinary field to include inspiration from European space research and technology as foundations for STEAM activities. An underlying question for the current document is therefore *“in what ways are STEAM activities which are inspired by innovative space-related technology and engineering different than STEAM activities inspired by other scientific themes”*?

Innovation may be thought of as creativity applied (Robinson, 2011). An important issue for the SPACE project’s Pedagogical Framework is, therefore, that of how the project conceptualizes creativity on the road to innovation of the kind described above. This Pedagogical Framework is thereby structured in two sections:

Section 1) Theoretical approach¹

Section 2) Practical example of WASO implementation based on a recent European Space Agency technological development

¹ Acknowledgment: Section 1 of the Pedagogical Framework relies on argumentations developed in the context of the Theory and Ethics of Science PhD course (VITHF900) at the University of Bergen by PhD candidate Oded Ben-Horin (2016). The sections of material which were adapted for the purpose of Section 1 of this document were thereby used with permission.

Section 1) Theoretical Approach

The question of how to theorize creativity within the SPACE project requires attention. We need to understand the phenomenon of creativity in the context of teaching and education and, more precisely, what it is we are doing that *enables* creativity to emerge. To this end, we rely on Living Dialogic Space (Chappell & Craft, 2011), a theoretical approach to creativity in education, as a way of understanding creativity within the SPACE project's context and as a point of departure for a discussion about actual, "astronomical" space's role in the SPACE project's pedagogical frame.

Chappell & Craft (2011) theorized Living Dialogic Space (hereafter LDS) as research spaces which enable debate and difference of opinions amongst various stakeholders in educational settings. These may be pupils, pre-service teachers, teachers, artists, researchers or external persons (e.g. policy-makers). LDS enables a "bottom up" approach to the educational setting (Craft, Chappell & Slade, 2014) thus typically departing from "usual hierarchical, top-down power conversations expected within schools" (Chappell & Craft, 2011, pg. 364). This opens (metaphorical) "spaces" which promote a sense of equality among all those involved. Chappell & Craft (2011) specified LDS as an attempt to encourage risk-taking in the space between two opposing views of the educational setting: The educator's wish to implement creative teaching on the one hand, and macro-level tendencies (such as a focus on standardized testing) on the other. In order to move towards educators' implementation of creative teaching, they provided a methodological tool which exemplifies LDS and facilitates its production: the Creative Learning Conversation.

In conceptualizing LDS, Chappell & Craft (2011) relied on three distinct theoretical sources: Bronfenbrenner's (1979) bio-ecological theory, Lefebvre's (1991) spatialisation of thinking, and Bakhtin's (1984) work on the subject of dialogue.

Chappell & Craft (2011) situated LDS within Bronfenbrenner's bio-ecological theory (1979), in which local phenomena are nested in a larger ecological environment, such as the social and cultural ones. The personal level of interaction amongst individuals reflects Bronfenbrenner's concept of the microsystem. The mesosystem is comprised of multiple microsystems developing inter-relationships, which in LDS can be exemplified by classroom culture or school policies. The exosystem refers to contexts which do not necessarily involve the individuals in question directly yet which affect micro and meso-systems. Exosystem may be exemplified by local educational authorities' attitudes towards creativity. The macrosystem represents the wider, more complex network of "inter-connected" systems which relate to ideology or governmental policy which impact school organization or curriculum. In the context of the SPACE project, the macro-level may be exemplified by the previously-mentioned focus on performativity which has the impact of educators' often avoiding risk-taking in the lower levels of Bronfenbrenner's ecological model. Originating in the field of psychology, Bronfenbrenner (1979, pg.

17) critiqued psychological analysis of individuals' development which failed to take into account the impact of various levels of the ecological system on that development. Chappell & Craft (2011) correspondingly constructed LDS theory as a micro and meso-system interaction with larger systems' impacts upon them as well as the individual's creativity's potential impact on her exo and macro-systems.

In their evoking of the term "space", Chappell & Craft (2011) based their theory on an understanding of the nature of spaces for which they relied on Lefebvre's (1991) work on spatialisation of thinking. Lefebvre differentiated between perceived, conceived and lived space as parts of the *social* space. (He referred to physical space as "absolute space", a notion which will be returned to in the pages below). In this view, perceived space relates to spatial practice of everyday routine. Conceived space relates to abstractions of principles such as "conceived roles and relationships" (Chappell & Craft, 2011, pg. 376). Lived space relates to bodily experience. In the absence of lived space, "the imagination could never capture the experiential complexity, fullness and perhaps unknowable mystery of actual lived space" (Chappell & Craft, 2011, pg. 377). Lived space is "qualitative, fluid, and dynamic" (Lefebvre, 1991, pg. 42, as quoted in Chappell & Craft, 2011, pg. 377). Within the context of the Write a Science Opera (WASO) intervention it is apparent in, for example, the extensive group work during which movement-based workshops are implemented in order to enact the drama, music and scenography inspired by, and communicating, scientific phenomena. Lived spaces are characterized by lack of closure, and thus capacity for *change* realized through dialogue. Chappell & Craft (2011) rely on Bakhtin (1984) in order to theorize their use of the concept of that dialogue. Working in literary analysis, Bakhtin argued that open-ended dialogue was the "single adequate form for verbally expressing authentic life", and that "every thought and every life merges in the open-ended dialogue" (Bakhtin, 1984, p. 355, as quoted in Chappell & Craft, 2011, pg. 377). Chappell & Craft (2011) relied on Bakhtin's work on dialogue as "shared enquiry...forming a continuous chain of questions and answers" (Wegerif, 2010, pg. 25, as quoted in Chappell & Craft, 2011, pg. 378). Bakhtin's specification of dialogue as an end in itself (1984, pg. 252) which enables individuals to discover both themselves and others (as co-creators) is therefore of paramount relevance. Indeed, dialogue invokes the ability to listen to others and rethink, by "identifying with the space of dialogue" (Chappell & Craft, 2011, pg. 377). It is therefore precisely here that the works of Lefebvre on spatialisation (1991) and Bakhtin on dialogue (1984) meet to provide a theoretical overlap which informs LDS within the Bronfenbrenner bio-ecological system (1979).

Creative Learning Conversations

In order to exemplify and *create* Living Dialogic Space, Chappell & Craft (2011) proposed Creative Learning Conversations as methodological devices. Creative Learning Conversations may include (but are not limited to) partnerships between teachers and artists or co-creation of role play and games with symbolic elements which elicit discussion in educational settings (Craft et al, 2014). They allow educators and pupils to become collaborating "researchers" who, together, develop multiple

perspectives in an environment which encourages partiality, emancipation, participation, debate, openness to action, subjectivity, and embodied and verbalized exchanges of ideas (Chappell, Craft, Rolfe & Jobbins, 2012, pg. 7). In practice, Conversations involve two action types: *re-positioning* and *listening-actioning*. The former entails a change in relationships such as when pupils and teachers interact in a flat-hierarchy environment induced by physical or metaphorical repositioning. Listening-actioning follows: Chappell & Craft (2011) observed teachers taking time to engage with pupils towards action and seriously considering pupils' ideas as a result of the methodological Conversations. Within this context, engaging with difference of roles and relations leads to change of practice, and, thereafter, changes in how pupils *create*. Living Dialogic Space (LDS) consequently builds upon a didactic orientation towards educational design as a common space for various stakeholders. In LDS, imagination is employed in order to, for example, allow pupils to take on roles of other stakeholders so as to enable freer debate. It is here where the Conversations enable creativity to emerge, and where LDS provides an understanding of that creativity.

As previously mentioned, another important context of Living Dialogic Space is its existence in tension with macro-level tendencies (Chappell & Craft, 2011). These largely relate to governments' striving for standardized pupil achievements which often cause creative interventions to be viewed as unjustifiable. This tension is not unique to the specific theory of Living Dialogic Space, but is rather a general reality emerging on the macro-level (Biesta, 2014). What is unique to LDS in this context, though, is Chappell & Craft's (2011) theorizing LDS as a way of creating a space so as to enable educators to *welcome* risk-taking. And it is here where the SPACE project lays its claim to innovation by providing opportunities and necessary tools for future educators to handle that risk. Creative Learning Conversations are thus methodological devices which stimulate change by supporting partiality and subjectivity, and can both exemplify and produce Living Dialogic Space.

The SPACE project's actions must now be discussed with regard to their qualifying as creative according to the theory presented. The Write a Science Opera (WASO) intervention exemplifies the SPACE project's STEAM (Science, Technology, Engineering, Arts, Math) approach. WASO departs from a more traditional lecture-style teaching. The intervention entails art and science educators guiding and supporting pupils' creation of an original science-inspired artistic performance. Pupils explore the chosen topic by engaging with drama, music, and visual arts practices, corresponding to Creative Learning Conversations' typical reliance on a variety of media. Activities in both science and art are constructed as physical and social occupation of shared space, enabling what Chappell & Craft termed "Living Space" (2011). The intervention necessitates an altered physical space (activities are usually realized in workshop-format and group-work is the norm). A bottom-up, participatory approach is employed to generate ideas. During the intervention (which may vary in duration, extending from 1 day to 1 year), pupils establish an "opera company", and assume roles such as composers, scenographers, orchestra musicians, actors, singers, company leaders, and science or math researchers. This

metaphorical *re-positioning* is necessary in Creative Learning Conversations, and enables pupils' interaction with teachers in a flat-hierarchy environment. Furthermore, while pupils are chosen for their "opera company" roles by teachers, artists and scientists, this occurs only after those educators have considered pupils' preferences and requests for respective roles. During the intervention, many "products" are developed, such as songs, paintings, poems, and science communication material. These are created by using one pupil's idea as raw material for other pupils' products in a continuous, cyclical process which thus involves several pupils in each product's development. This constant negotiation of multiple perspectives exemplifies the importance of LDS theory's dialogic nature, and allows pupils to recognize their own contribution in all products. Furthermore, in LDS theory, *listening-actioning* entails teachers taking time to engage with pupils towards action and seriously considering their inputs as a result of the Creative Learning Conversation. This type of listening-actioning is typical of the intervention in question.

Before we attempt to describe actual (astronomical) space in section 3, it is important to specify that Lefebvre's conceptual triad does not imply a conscious shifting between various categorizations of space on the part of the subject in question (e.g. primary school pupils). Rather, it provides a way of conceptualizing and producing social space within a given society (e.g. classrooms). Lefebvre described **spatial practice as perceived space**. Here, the SPACE project's intervention impacts pupils' everyday routine, which is largely disrupted by the innovative intervention. We observe the negotiation of those changes and ensuing social interactions with the triad's two other ideas of space. **Conceived space, or Representations of space** was theorized by Lefebvre as having to do with abstraction of principles such as conceived roles and relationships of teachers, artists, students and researchers which identify what is lived and perceived with what is conceived. This is where the SPACE project's WASO intervention offers pupils the opportunities to be cast in new roles, and learn how production of new (social) space impacts their ideas of their own learning environment. The third characterization, and from which LDS gets its name, is **lived space, or representational space**. It relates to bodily experience, yet that bodily experience does not actually occur *in* Lived Space. Rather, it is a representation *of* bodily experience. It has meaning through associated images and symbols. It overlays physical space, making use of its objects. It requires openness, which Chappell & Craft (2011) claim they see in Creative Learning Conversations, where potentiality is extrapolated, shaped and constructed through physical and social occupation of shared space. For the SPACE project which is part of the "STEM to STEAM" movement, this is a space where meaning is made. **This is where art and science meet in the ideas of the child.** It is also where solving the problem of such a complex task is negotiated by the child, where physical objects such as artefacts are given symbolic meaning, and where we may make symbolic use of the stage, itself a physical object, as a science learning arena.

In order to approach Lefebvre's theory of social space more deeply, we must now observe two aspects of Carl Marx's thought (Production and Dialectic) which provided main sources of inspiration for Lefebvre.

1: Production

Marx regarded the material conditions of a society's mode of production (its way of producing the means of human existence or, in Marxist terms, the union of its productive capacity and social relations of production), as fundamental in determining its organization and development. Marxists believe they can and should reorganize society by changing its mode of production. Lefebvre shifted towards active production of social space. For him, space was a complex social construction which included the social production of meaning. His conceptual triad can thus be seen as a framework within which to understand interplay between ideas and meanings, and their actual production. LDS theory, in turn, relies on *producing* new social space within the classroom. The SPACE project relies on new design for interactions within the social space in the classroom. Results of these, which adhere to a renegotiation of the mode of knowledge production, are exemplified through transferring of ownership of that production to pupils by allowing it to emerge (creatively) without dictation from educational authorities, thus a reliance on a flat-hierarchy structure. In the WASO intervention, nobody has complete control over knowledge produced. It can only be produced *collectively* according to the methodological approach employed. Furthermore, Lefebvre's argument for a different mode of spatial production than that which reigned under capitalism (he termed the latter "abstract space") also implies an avoidance of alienating people from their own work and creativity due to a misuse of social production of space. This also informs LDS theory's support of the intervention as it seeks to avoid top-down power chains by encouraging the child's exploration of her own emerging ideas.

2: Dialectic

In Marx's approach to dialectic, ideas and material are created through their interaction. LDS theory overlays the Creative Learning Conversations practical methodology to open spaces within which to negotiate stakeholders' differences of opinion and/or perspective. In the WASO intervention, as an example, physical artefacts are constructed to allow exploration of science and art simultaneously, as different points of view. It is the creative educator's task to provide pupils with tools to create artefacts which reflect those underlying inter-disciplinary ideas. The *living space* of dialogue corresponds to what was theoretically articulated by Lefebvre: In the Creative Learning Conversations methodology, conceptual maps, for example, or collaborative games, encourage dialogues which, then, *themselves* raise new questions. Now, though, we must consider the ecological placing of this in order to understand how the intervention functions: where is this occurring in relation to Bronfenbrenner's (1979) ecological model? Creative Learning Conversations create Living Dialogic Spaces strongly located in the *meso-system*, in which *micro-systems* interact. Tensions are often experienced here with external impacts of

the exo-system in dialogue with microsystems. They have potential for conflict and difference, without necessary resolution, and are reflective and embodied. The dialogic dimension is where the exo-system and macro-system become visible in framing the meso-system, and thus where the space opened up by engaging with the LDS theory to begin with, may be negotiated. In the engagement between microsystems within the meso-system, influences, constraints, and opportunities are experienced emergent from the wider exo-system (for example of funding and priorities) and macro-system (for example governmental policy for educational engagement). Therefore, given the dynamic nature of each ecological level, the space dimension of LDS seems highly important in locating not as a fixed or hierarchical space, as Chappell & Craft (2011) specify, but as a space of counter-possibilities, where conceptual, emotional, identity and other exploration can occur. It is therefore here that an option to governmental policies of performativity, often focusing on achievement in what is referred to as “core” learning areas, and an extensive reliance on quantitative test-scores which focus on achievement in what some consider to be a limited way, may be exercised.

In the following two sections, a specific example of the extension of inspirational material for WASO activities to (astronomical) space is provided (section 2), followed by a discussion of that extension’s impact on creativity in the (new) social space based on the description of LDS in section 1.

Section 2) Practical example of WASO implementation based on a recent European Space Agency technological development

In past years, the Write a Science Opera (WASO) educational approach has been implemented based on inspiration provided by a large variety of scientific phenomena. In this section, a first step² is made towards the extension of the main inspirational source for a WASO activity to a *technological* development conceptualized and executed by the European Space Agency (ESA).

The Solar & Heliospheric Observatory (SOHO) is a project of “international collaboration between ESA and NASA to study the sun from its deep core to the outer corona and the solar wind” (ESA, 2018). Composed of a large variety of scientific instruments, SOHO was set in motion in 1995, and positioned 1.5 million kilometers from the Earth, where the gravity of the Earth and Sun are in balance at Lagrange Point No. 1 or L1 (1% of the distance between the Earth and Sun). In this way, SOHO could “remain hovering around that relative position, in a

² While the complete description of the practical school-based implementation lies beyond the scope of this pedagogical document, the process is hereby set in motion by providing the necessary example(s) and directions for their use in the WASO process.

“halo orbit”, undisturbed by sunsets, while it accompanies the Earth in its orbit round the Sun” (ESA, publication date not specified). In its place in space, SOHO was required to stare at the Sun “without letting its telescopic eyes wander by more than a few ten-thousandths of a degree” (ibid).

Despite the brevity of the italicized text in the paragraph above, it succeeds in providing inspiration for our example. The following questions arise: 1. Which elements of the technological endeavour should provide inspiration for our art project? 2. How do we make the “transfer” between the disciplines?

As is befitting an inquiry process, there is no single “correct” solution to either of these questions.

With regards to question 1, suffice it to say that the SPACE project considers every and any detail of the technological endeavour as ripe with enough information to spark a creative arts-infused process. With regards to question 2: The fact that SOHO was placed at 1% of the distance to the sun, for example, may be artistically interpreted in many ways (e.g. through graphical depictions of that ratio in costumes or scenography, a musical composition which accentuates every 100th beat, etc.). The challenge of avoiding the telescopic eyes’ wandering may similarly be depicted through a variety of artistic expressions (a minimalistic musical or dramatic expression, an “inflexible” dramaturgical expression, etc.).

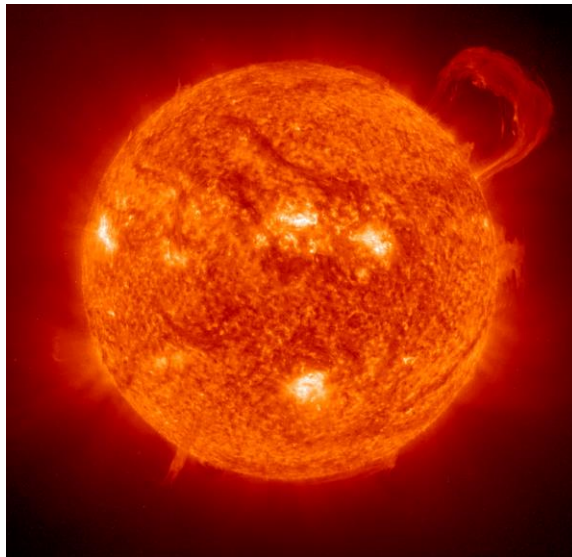


Image of a huge, handle-shaped prominence taken on Sept. 14, 1999 -- Prominences are huge clouds of relatively cool dense plasma suspended in the Sun's hot, thin corona. At times, they can erupt, escaping the Sun's atmosphere. Credit: SOHO (ESA & NASA)

Another approach to both questions 1 and 2, however, would be to find elements of the technological endeavour, or that which discovered and/or enabled, which resonates with one or more artistic expressions. An example: One of the significant foundations providing ESA's perspective of the SOHO mission is the discovery that the sun “sings to itself” (ESA, publication

date not specified). While too low for human hearing, solar physicists can still detect rhythmic motions in the solar surface, produced by sound waves reverberating inside the Sun. The resulting oscillations have precisely defined frequencies, like musical notes and overtones, and on analysis they give novel information about the way the Sun is built (NASA, 2018). And so, it is possible to begin “at this end” of the art/science interaction and use “musical” aspects of the Sun to embark upon the WASO process.

Regardless of the approach chosen during each specific WASO implementation, however, it will be the creative ideas and questions of the pupils which define its character and development.

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