DOI:10.6531/JFS.201812_23(2).0004
ARTICLE
.45

Students' Abilities to Envision Scenarios of Urban Futures

Iris Pauw
VU University Amsterdam
The Netherlands

Tine Béneker
Utrecht University
The Netherlands

Joop van der Schee
VU University Amsterdam
The Netherlands

Rob van der Vaart
Utrecht University
The Netherlands

Abstract

In this paper, we report on students' abilities to envision scenarios of urban futures after a lesson series based on futures education. The results on the critical and creative scenario thinking of geography students in three upper secondary schools improved significantly between a pretest and posttest. However, embedding newly imagined ideas in the spatial structures of tomorrow's cities turned out to be challenging for students. Although geographical knowledge and skills do seem to support students in scenario thinking, it appears to be a complex task to effectively combine knowledge and imagination in scenarios of urban futures.

Keywords: Futures Education, Urban Futures, Scenarios, Geographical Knowledge, Imagination.

Introduction

It may seem evident that education focuses on the future. Already in 1974, the cover of Toffler's classic 'Learning for Tomorrow, the Role of the Future in Education' stated: "All education springs from images of the future and all education creates images of the future". However, the future itself is rarely an object of study, as noted by Hicks (2006): "If all education is for the future where is the future explored in education?" (p.8). Most references to the future in education are tacit, token, or refer to a fixed, taken-for-granted future (Gough, 1990).

In the scientific disciplines of futures studies and futures education, researchers advocate a different, systematic and more open approach to future times (Bell, 2009; Botkin, Elmandjra & Malitza, 1979; Dator, 2009; Hicks, 2012; Inayatullah, 2008; Slaughter, 1996). Advocates and researchers of futures education seem to agree on three main principles. The first principle is study of multiple futures, stressing the importance of plurality (Bell, 2009; Hicks, 2012; van Steenbergen, 2005). The second principle is the imagination of novelty as an essential complement to knowledge (Dator, 2011; Hicks, 2012). The third principle is the commitment to work towards preferred futures, seen as a better choice than apathy (Rogers & Tough, 1996; Botkin et al., 1979; Slaughter, 1996).

Potentially, geography education – the four authors' domain of expertise – is an excellent partner for futures education, given geography's focus on a multi-dimensional approach to spatial issues from local to global scales (Hopwood, 2011; International Geographical Union, 2016; Pauw, 2015). Geography educators recognize their responsibility in contributing to the exploration of futures and explicitly acknowledge the importance of creative imagination in geography education (Fairgrieve, 1926; Lambert and Balderstone, 2010; Martin, 2011; Massey, 2006). The open, critical, and creative education that these geography educators envision involves uncertainty, and requires reflective and evaluative skills, or, in other words: it assumes higher-order thinking skills and complex modes of thinking that generate multiple solutions (Resnick, 1987). Anderson and Krathwohl (2001) see the ability to create as the highest level of thinking in their revised taxonomy of Bloom (1956). Since the core of futures thinking consists of creating multiple ideas, higher order thinking is also indispensable for futures education.

In practice, however, neither futures education nor the innovative ideal-type of geography education outlined above has yet gained momentum in secondary schools (Bateman, 2012; Hicks, 2012; Lambert & Balderstone, 2010; Roberts, 2013; Scoffham, 2013; Slaughter & Beare, 2011; Standish, 2013). In an earlier study we found that Dutch teachers see critical and creative thinking about futures in school geography as important, but impracticable (Pauw & Béneker, 2015). Other studies confirm that teachers are hesitant towards the use of creativity in other subjects than the classic art subjects such as music and drawing (European Commission, 2010; Newton, 2012; Scoffham, 2013). Teachers are generally risk-averse in their pedagogy, and they believe that there is insufficient clarity about the exact formal requirements, the methods, and the results of open and future-oriented geography education that could build on students' imagination and creativity, as well as on their basic cognitive knowledge and understanding (Pauw & Béneker, 2015). According to Hicks (2012): "Teachers, teacher educators and educational publishers still find it difficult to grasp the nature of futures and futures thinking because they take it to be too abstract for the classroom" (p.12). In practice, teachers focus on lower-order learning in their classes, since this is what is required in mandatory national exams (Bijsterbosch, van der Schee, & Kuiper, 2017; Krause, Béneker, van Tartwijk, Uhlenwinkel, & Bolhuis, 2017). Futures education itself faces similar problems, with a lack of both authority and perceived practicability. Futures education is barely seen in curricula, and even successful projects do not persist but instead "end up in the too-hard basket" (Slaughter, 2007, p.47). Teachers consider futures relevant, but too complex to grasp in class. A complex innovation such as futures education is less likely to succeed when it is not obligatory and

not elaborated in clear, evidence-based examples (Bednarz, 2003; Gidley, Bateman, & Smith, 2004).

In our research project we developed a series of future-oriented lessons for geography in upper secondary schools, with design principles based on futures education and innovative geography pedagogy. The design of these lessons will be discussed only briefly in this paper (for a more extensive discussion, see Pauw, forthcoming), since our focus is on the learning outcomes of the lessons. We hope that our results will contribute to education research and teaching by providing the examples and empirical evidence that can help teachers to overcome their skepticism.

Our series of lessons focuses on urban futures. The subject of urban areas is part of school geography curricula all over the world, and most students grow up in an urban environment (Béneker, Sanders, Tani & Taylor, 2010), so studying and imagining tomorrow's cities seems plausible. Also, in the field of futures studies, cities are referred to as "agents of global change and key elements of foresight exercise" (Vanolo, 2016. p.26).

The aim is to engage students in the mental and social activities of scenario thinking. The lessons are not about 'learning' the images of future cities as developed by experts, or 'learning' definitions and techniques of scenarios and scenario development. Instead, in the classroom activities, students engage in activities such as:

- Exploring the range of future possibilities by developing multiple scenarios for future cities, thereby using their imagination and creativity, in combination with their knowledge about cities and societal developments;
- Making connections between social trends today and probable urban futures;
- Distinguishing probable, possible, and preferable futures, using analytic, imaginative, as well as moral-ethical reasoning;
- Brainstorming and discussing the value-laden aspects of urban futures.

In this way, students practice what both geography educators and futures education scholars promote as urgent innovations, i.e. breaking away from 'correct answer' reflexes, using imagination as a complement to formal knowledge, engaging with futures, et cetera (Gidley, 2016; Hicks, 2007; Martin, 2011; Roberts, 2013). By using imagination, for example by means of divergent thinking (Guilford, 1950), students can think beyond the fixed and familiar to arrive at novel, possible and preferable futures. Students may then become aware of how every future scenario is influenced by ideas about what is considered preferable: "The point is that the world 'out there' is framed, understood and conditioned through the world 'in here'" (Slaughter, 2002, p.29).

The aims of our lesson series can only be realized when teachers withhold from 'teaching' about probable futures, but rather invite and encourage students to think for themselves, imagine, reflect, and discuss. In our project, we therefore trained teachers to use the instructional strategy called 'scaffolding' (see Wood, Bruner, & Ross, 1976). "Scaffolding refers to support that is contingent, temporary and aimed at the transfer of responsibility for a task or for learning" (van de Pol, 2012, p.199). This means students are supported in their scenario development for as much and as long as they need to progress towards independent scenario thinking.

Research question

The goals and classroom activities of our lesson series about urban futures are different from mainstream geography classes, and from most secondary school activities. In our research project, we wanted to explore to what extent futures learning is feasible in a formal school context. After all, as explained above, many teachers are skeptical about futures education in their classes. Therefore, our main research question is:

> *To what extent are upper secondary school students able to think in terms of scenarios for urban futures?*

A scenario can be defined as "not a future reality but a means to represent it with the aim of clarifying present action in light of possible and desirable futures" (Durance & Godet, 2010, p.1488). Scenarios are powerful tools for futures thinking because they respect two key characteristics of future times: the future is open, but it is not an empty canvas (Bell, 2001; Dator, 2002; Veenman & Leroy, 2016).

First research sub-question

We have tackled the question by means of an intervention study. The intervention in this case is the controlled experiment of a five-hour series of lessons about urban futures. On the basis of a pretest and a posttest, we were able to answer this first sub-question:

To what extent do students' abilities to think in terms of scenarios for urban futures improve after an intervention based on futures education?

It may appear self-evident that an intervention of instruction and well-chosen learning activities improves the ability of students to think in terms of scenarios. Earlier studies have shown, however, that many teachers are skeptical about futures education as learnable and teachable (Hicks, 2012; Pauw & Béneker, 2015). During the intervention, three building blocks for scenario thinking are used. These building blocks are the framework for the analysis of the tests in section 3.

1. The first building block is 'knowledge and skill application'. This building block is indispensable to scenario design, as it reactivates and enlarges students' knowledge and skills on urban areas, necessary for scenario design. We distinguish prior and new knowledge and skills:
   a. prior geographical knowledge and skills: the students in our experiment already have geographical knowledge and skills from earlier classes, such as knowledge about urban structures and urban functions;
   b. new knowledge and skills: knowledge of trends is provided to enlarge students' understanding of processes in urban areas. Four trends are introduced: an ever-stronger focus on sustainability; technology development; individualization; and deregulation (the process of a changing role of the government, including processes such as privatization and deregulation). During the intervention students' skills to use multiple trends are trained.
2. The second building block is 'creative scenario design' for urban futures. Students use not only knowledge and skills but also imagination, to creatively think beyond the familiar. With regard to aspects or phases of creative imagination, we only checked the ability of divergent thinking (coming up with alternatives about urban futures) as part of research sub-question 1 A more extended analysis of creative imagination is done later concerning the second research sub-question 2.
3. The third building block is 'critical scenario evaluation' in which students use not only knowledge, skills, imagination, but also moral-ethical reasoning to include more than just analytical arguments in their reasoning about what to consider preferable futures.

Second research sub-question

To learn more about how different building blocks are successfully combined in students' notions of the future, we analyzed sketches made by the students during one of the lessons of the intervention. This analysis focuses on the first two building blocks mentioned above: knowledge and skill application as well as creative scenario design. The second sub-question is:

What combinations of prior geographical knowledge and skills, knowledge of trends, and imagination are visible in students' scenarios?

The results are discussed in section 4. Envisioning futures with the use of imagination is considered a crucial step in empowering students to create their desired futures (Gidley et al., 2004; Hicks, 2012). However, not all imagination is equally valuable for scenario thinking. Based on literature about creativity in education (Bruner, 1962; Cropley, 2001; Finke, Ward, & Smith, 1992) we distinguish three subsequent phases towards creative imagination: divergent thinking, novelty and creativity. Imagination starts with divergent thinking (Guilford, 1950), which becomes more relevant for scenarios when it is unorthodox and surprising, qualities also referred to as 'novelty' (Bruner, 1962). Novelty becomes even more valuable when it is also effective, by serving a purpose. Novel, effective imagination is considered to be 'creative' imagination (Cropley, 2001). This implicates that creative imagination involves the use of knowledge. In section 4, therefore, we will analyze students' sketches through the lenses of different kinds of knowledge (prior geography knowledge and knowledge of trends) and three phases of imagination (divergent thinking, novelty and creative imagination). In this sense, the analysis of creative scenario design is more elaborate here than under sub-question 1, where we will only analyze students' ability of divergent thinking.

Method

This method section consists of three subsections. First, we provide general information about the lessons and data collection (2.1). Then, we focus on two methods of data collection to answer the research questions: a pretest and posttest design (2.2) and an analysis of the sketches made by the students during the lessons (2.3).

General Information

Table 1 presents a summary of the series of lessons on urban futures for upper secondary geography students. The aim of the lesson series was to stimulate students' critical and creative thinking about tomorrow's cities. Students had to prepare, design, and evaluate scenarios of urban futures using their geographical prior knowledge, knowledge of trends, and imagination. As shown in Table 1, after a general introduction (lesson 1), important learning activities were analyzing trends (lesson 2), designing scenarios (lesson 3), and evaluating probable and possible scenarios (lesson 4) before choosing a preferable urban future (lesson 5). The lesson series consisted of five lessons, preceded by a pretest and finished with a posttest. Earlier, two prototypes of the lesson series were tested with other students in the same age group. The third and final version of the series of five lessons on urban futures took 300 minutes, excluding the pretest and posttest. Three geography teachers with university degrees volunteered to use this lesson series in 2016 in five classes in three secondary schools in the Netherlands. A total of 142 pre-university students aged 16, 17 and 18 participated. The lessons were new to the students. The teachers prepared by attending a 2-hour training session led by a researcher. The teachers kept a logbook to report on the progress of the lessons. A researcher observed two lessons per school class in order to get an impression of how the intervention was working.

Table 1. *Summary of the series of lessons on urban futures*

Aim: students prepare, design, and evaluate scenarios of urban futures, using their geographical prior knowledge and skills, knowledge of trends, and imagination.	
Content per lesson	*Main student activities*
Pretest	Students prepare, design and evaluate scenarios for a yet to be developed urban area.
Introduction: becoming engaged	For getting into the subject, students choose one out of three introductory assignments about creative perspectives on futures: students explore an idea for a radically different future, developed by a critical designer, *or* they explore personal ideas about urban futures in peer interviews, *or* they imagine radically different urban futures. The assignments require the use of students' ideas about futures and introduce them to more open, creative learning.
Knowledge and skill application: the study of probable urban futures	Students study and discuss four trends: *sustainability; technology development; individualization; deregulation*. They analyze the spatial appearance of each trend in changing urban areas (in recent history, at the current time, and in probable future times), thereby including connections to other spatial scales (e.g. regional, national, global). They use prior geography knowledge and skills.
Creative scenario design: the exploration of possible urban futures	Students design spatial scenarios for the city of the future, based on: - prior geography knowledge and skills about urban artifacts, actors, activities, and spatial relationships both within the city and between the city and other spatial scales; - knowledge about trends: a chosen combination of two trends is the framework for a sketched scenario; - imagination.
Critical scenario evaluation: analyzing preferable urban futures with peers	Students analyze, discuss and evaluate multiple probable and possible scenarios for urban futures. They use prior geography knowledge and skills, knowledge about trends and imagination and moral-ethical reasoning.
Critical scenario evaluation: analyzing and evaluating urban futures individually	Students formulate their own preferred urban future scenario, underpin it with analytic and moral-ethical argumentation, and think of an imaginary opponent and its counterarguments. They use prior geography knowledge and skills, knowledge about trends and imagination and moral-ethical reasoning.
Posttest	Students prepare, design and evaluate scenarios for a yet to be developed urban area.

The pretest and posttest design

To investigate the effect of the lesson series, the four researchers developed a test that was used as both a pretest and a posttest. Table 2 gives a summary of the test. The test focuses on an authentic

case study about a spatial design question in the medium-sized and fast growing Dutch city of Almere in 2016. Students were asked to think about the yet to be built center of a residential area that was also still in development. Basic information about the spatial situation of the neighborhood and its center was provided in the test, as well as information in which students could recognize trends affecting the spatial situation.

The test consisted of three assignments concerning the three building blocks for scenario thinking: knowledge and skill application; creative scenario design; and critical scenario evaluation. The first and last assignment were split up into smaller sub assignments. In total, students could score 21 credits for 21 items in the test, as can be seen in Table 2. In assignment 1 about knowledge and skill application, students had to recognize and analyze trends and relate developments at different scales. This first assignment was relatively large since this the activation of students' knowledge and skill base required several steps. In assignment 2, students designed two possible scenarios for the future neighborhood center and explained their sketches. This second assignment was the most innovative part, since students had to combine knowledge and creativity. Finally, in assignment 3 students selected their most preferred scenario, motivated their choice, and evaluated it from different perspectives. In this last assignment, knowledge and creativity are complemented by students' reflection on values. A tryout with a prototype of this test was used in another secondary school geography class with the same age group.

Table 2. *Summary of the content of pre- and posttest*

Context: In the case study test, students were asked to design and evaluate two scenarios for the center of a new neighborhood in the medium-sized Dutch city of Almere.
Summary of the test assignments
Knowledge and skill application to prepare scenarios in 3 sub-assignments with 10 items
Students had to: - *name two trends that could be recognized in the dataset (2 items).* - *design a street view image of the new neighborhood that contains spatial elements that were not seen in a neighborhood 50 years ago. Add an explanatory statement. Relate the sketch to a trend, and add an explanatory statement about this relationship (4 items).* - *name two expected future changes that are related to urban futures in the Netherlands: on the national scale and on the global scale. Explain how these changes could become visible in the future street view image of Dutch neighborhoods (4 items).*
Creative design of scenarios in 1 assignment with 6 items
Students had to*:* - *sketch two scenarios of the future neighborhood center, while using prior geographical knowledge and skills, knowledge of two trends, and their own imagination. Add two short explanatory statements.* *(3 items in two sets of a sketch and explanatory statement: 6 items).*
Critical evaluation of scenarios in 2 sub-assignments with 5 items
Students had to: - *make a case for their favorite scenario, while using an argument based on their prior knowledge and an argument based on their personal values (2 items).* - *make a case against their favorite scenario, while using an argument based on their prior knowledge and an argument based on their personal values, and give an example of an opponent (3 items).*

Out of 142 students who took the test, 89 students were present during both tests and all five lessons. Their tests were selected for assessment. The pretest and posttest were assessed by the researcher (the first author of this paper). For the purpose of inter-rater reliability, a second researcher assessed 10 pretest (11%) and 10 posttest (11%). The assessors independently listed six scores per test: three for each sub assignment of assignment 1, one for assignment 2 and two for each sub assignment of assignment 3. The assessors were aware of whether it concerned pretests or posttests and used a rating model agreed beforehand. The average measure Intraclass Correlation Coefficient (ICC) showed a high degree of reliability:

- The average measure ICC of the pretest ratings was .920 with a 95% confidence interval from .867 to .953 ($F(59,59) = 12.390$, $p < .001$).
- The average measure ICC of the posttest ratings was .889 with a 95% confidence interval from .812 to .935 ($F(59,59) = 9.459$, $p < .001$).

The minor differences in scores were discussed until a consensus was reached, and the rating model was adjusted. The results of the pretest and posttest are presented in section 3.

The analysis of scenario sketches

To answer the second research sub-question we focused on students' sketched scenarios of urban futures that were drawn in the third lesson, as shown in Table 1. Our aim was to see what combinations of the two building blocks of knowledge and skill application and creative scenario design were visible in these students' sketches.

The four researchers looked at the difference between sketches in which knowledge and imagination are successfully combined, and sketches that lack a fruitful combination.

We analyzed six sketches, case by case. This concerned three high scoring sketches and three low-scoring sketches, based on a rating process that will be explained later in this paragraph. For each sketch, we first noted where we saw imagined novelty, i.e. surprisingly new ideas. Then we determined whether the combination of novelty with geographical prior knowledge and skills and knowledge of trends was visible, and whether this resulted in an integrated scenario of an urban future.

We selected six sketches out of a total of 55 sketches, drawn by 114 students, working in pairs, during 40 minutes in the third lesson of the series. The student population here was larger than in the pretest and posttest ($N = 89$) because 114 students were present in the five participating school classes when these sketches were made.

We selected the six sketches as follows: first, we discussed three criteria to assess the sketches and practiced the assessment together. The criteria were based on a part of the rating model used for the pretest and posttest, as these tests also included sketches:

1) Are geographical prior knowledge and skills visible, in the form of urban functions, a spatial structure, and/or a focus on the human-nature interface?
2) Are two of the four trends visible, and are they integrated in a spatial context?
3) Is imagination visible, and is it novel and effective? Effectiveness is interpreted here as being embedded logically in the spatial context.

Then, we independently assessed the total of 55 sketches. Per criterion, 0,1 or 2 credits were given. Aim of this approach was not to generate valid scores for the sketches, but to create enough consensus about the visibility of fruitful combinations of knowledge and imagination. So when the scores of the four assessors differed by more than 1 credit regarding a criterion, that sketch was excluded from the analysis. All scores with sufficient agreement were grouped in five categories. Three sketches ended up in the highest category: all four assessors rated them in either category

4 or 5 on all criteria. These three sketches were the subject of further analysis. From the bigger group of 18 low-scoring sketches with all scores in the lowest categories 1, 2 and 3, we selected three representative sketches that included elements of knowledge and imagination: these were also subject of further analysis.

Thirdly, we together analyzed the visibility and fruitfulness of the combination of knowledge and skill application and creative scenario design in these six sketches, by thinking out loud and discussing our observations and interpretations. The results of our analysis are presented in section 4.

Results of the Pretest and Posttest

In this section we present results that answer the first sub-question: *To what extent can students' abilities to think in terms of scenarios for urban futures be improved through an intervention that facilitates futures education?* First, we present the results of the test as a whole. Second, we focus on the results per building block of scenario thinking: knowledge and skill application; creative scenario design; and critical scenario evaluation. After that, we briefly comment on results of relevant subgroups in the data and we close this section with final remarks.

Overall results of the tests

In the pretest the average student scored 35% of the credits and in the posttest 75% of the credits, so there is a clear progression. A paired-samples t-test confirmed that students' posttest mean scores were higher than their pretest mean scores (see Table 3).

Table 3. *Results of the pretest and the posttest as a whole*

Means pretest	SD pretest	Means posttest	SD posttest	Paired T-test score
7.41*	3.53	15.71*	3.06	$t(88) = -18.93, p < 0.01$

* out of a total of 21 credits

Test results per building block of scenario thinking

Student mean scores on pretest and posttest also differ significantly per building block, see Table 4.

Table 4. *Results of pretest and posttest per building block of scenario thinking*

Means pretest	SD pretest	Means posttest	SD posttest	Paired T-test score	Students who scored sufficient on pretest	Students who scored sufficient on posttest
Step 1: knowledge and skill application						Sufficient = 6 out of 10
4.19 (out of 10 credits)	2.51	8.41 (out of 10 credits)	1.57	$t(88) = -14.24, p < 0.01$	25 students: 28%	82 students: 92%
Step 2: creative scenario design						Sufficient = 3.5 out of 6
1.39 (out of 6 credits)	1.28	3.56 (out of 6 credits)	1.52	$t(88) = -10.87, p < 0.01$	10 students: 11%	52 students: 58%
Step 3: critical scenario evaluation						Sufficient = 3 out of 5
1.83 (out of 5 credits)	1.64	3.74 (out of 5 credits)	1.12	$t(88) = -9.34, p < 0.01$	28 students: 32%	61 students: 69%

Test results concerning knowledge and skill application

The average number of credits on knowledge and skill application doubles, as Table 4 shows. These results concern both the use of 'prior geographical knowledge and skills' and 'new knowledge' of trends in assignment one of the test (see Table 2). The number of students who score at least 6 out of 10, a score that can be considered "sufficient", increases from 28 % to 92% between the pretest and the posttest, as can be seen in Table 4. In the posttest, these assignments were too simple for half of the students, as this group scored an average of 9.5: a ceiling effect. This caused the 7 students who scored "insufficient" to be outliers, with one students' score being an extreme. Looking at the frequency with which students mention trends in their answers concerning open knowledge and skill application questions, we see that sustainability is mentioned most often in both pretest and the posttest. Table 5 shows that the students' use of all trends increased in the posttest.

Table 5. *Frequency of mentioning different trends in knowledge and skill assignment in pretest and posttest (N = 89)*

Trend	Pretest	Posttest
sustainability	18	76
technology development	5	59
individualization	5	53
deregulation	2	65

Test results concerning creative scenario design

As Table 4 shows, creative scenario design resulted in the lowest scores on both the pretest and the posttest. Also in the posttest, most scenarios are not yet fully developed. At the same time, students make more progress concerning this building block than concerning the other two. When we consider this progression in more detail, we first see an increased ability to imagine multiple futures, as in the posttest students design more scenario sketches. The assignment asked students to sketch two scenarios. In the pretest 20 students do not sketch at all, 62 sketch one scenario, and 7 students sketch two scenarios. In the posttest, 13 students sketch one scenario, and 76 students sketch two scenarios. Besides the quantity, also a better quality of the scenario sketches resulted in more credits for the posttest. As Table 4 shows, in the pretest 11% of the students scored at least 3.6 out of 6 credits, a score that can be considered "sufficient". In the posttest 58% reached this level. In the pretest one student obtained 5 credits (out of a maximum of 6) while in the posttest 22 students got this far or further.

For creative scenario design, students use not only knowledge and skills but also divergent thinking, to think about alternatives beyond the familiar. The results in table 6 suggest that progress in divergent thinking and in the use of knowledge might go hand in hand. Both the number of credits scored for divergent thinking and for the use of knowledge more than double. Table 6 also shows that there remains room for improvement in students' creative scenario design, since 41% of the credits remains unscored.

Table 6. *Percentage of credits scored in creative scenario design, per component (N = 89)*

	Credits Pretest	Credits Posttest
Divergent thinking	19%	59%
Knowledge and skills	25%	60%
prior geographical knowledge & skills	34%	64%
new knowledge of trends	17%	55%
Total	*23%*	*59%*

Looking at the frequency with which students use trends in their designs, Table 7 shows the same pattern as Table 5: Students use sustainability most often, and the use of all trends increases.

Table 7. *Frequency of mentioning different trends in scenario design assignment in pretest and posttest (N=89)*

Trend	Pretest	Posttest
sustainability	23	75
technology development	16	64
individualization	6	34
deregulation	5	20

Test results concerning the critical scenario evaluation

Table 4 shows that the ability to critically evaluate scenarios improves between pretest and posttest. As Table 4 also indicated, 32% of the students obtained 3 credits or more on the pretest, a score that can be considered "sufficient". In the posttest, this was 69% of the students. To obtain a sufficient score, students had to reason beyond their first reaction, by using different types of arguments or by looking at scenarios from different perspectives. For example, students frequently chose a sustainable, technologically advanced urban future as their preferred one and reviewed it as 'ecologically sound' and 'attractive', but in the second instance also as 'expensive'.

Looking at the frequency with which students use trends in their evaluations, we see a remarkable increase of technology development between pretest and posttest, as shown in Table 8. However, sustainability dominates in the answers to the questions concerning the evaluation of scenarios in both tests.

Table 8. *Frequency of mentioning different trends in the evaluation of the scenarios in pretest and posttest (N = 89)*

Trend	Pretest	Posttest
sustainability	30	30
technology development	0	12
individualization	5	7
deregulation	1	1

Test results of subgroups

Although we treat the data as one group, we here report on evident subgroups within the group as a whole.

Concerning different teachers and classes

The data show some differences between the three teachers and their five school classes, as displayed in Figure 1.

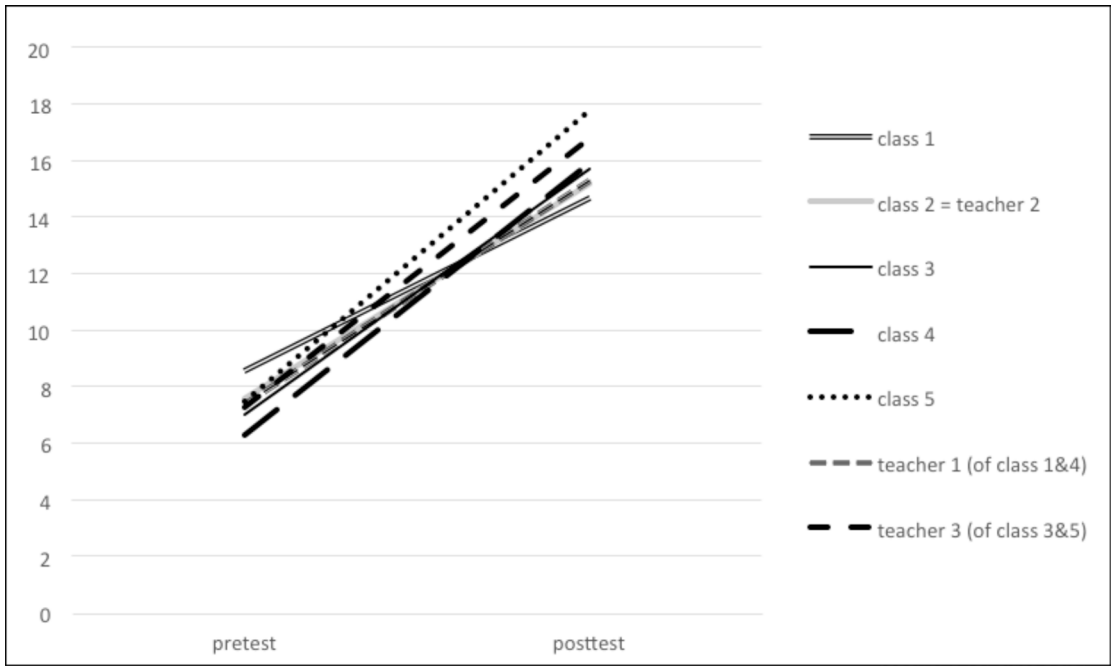

Figure 1. Mean results pretest and posttest per class and per teacher

No significant effect of the different teachers on the student's test scores (difference scores) was found: $F(2,86) = 1.692$, $p = 0.017$. The dependent variable *difference score* was created by subtracting each student's score after the intervention with their corresponding score before the intervention. This way a one-way ANOVA could be used to test the (possible) differences in the increase of scores among groups.

There was a significant effect of the variable school class on the student's test scores (*difference scores*): $F(4,84) = 3.193$, $p = 0.190$. Post hoc comparisons using the Tukey HSD test show that:

- it is the school class with the highest mean difference score ($M = 10.21$, $SD = 2.96$) that differs significantly ($p = 0.028$) from the class with the lowest mean difference score ($M = 6.12$, $SD = 3.49$);
- the mean difference scores of the other three classes ($M = 7.62$, $SD = 4.03$; $M = 8.73$, $SD = 4.75$; $M = 9.57$, $SD = 4.34$) do not differ significantly from any of the other mean difference scores.

Interpreting these differences any further goes beyond the scope of our paper.

Concerning low, medium and high scores

When we group students' scores in three categories – low, medium, and high – we see the students' progression in the different categories, as shown in Figure 2. The biggest group of 34 students proceeds from a medium pretest score to a high posttest score. A second group of 30 students makes a bigger step: from a low pretest score to a high posttest score. There is also a smaller group of 12 students who show progression from a low pretest score to a medium posttest

score. 12 students stay in the same category, one of whom repeats the same score and 11 make progress within their category (once in low, nine times in medium, and once in high). But one student falls back from a high pretest score to a medium posttest score.

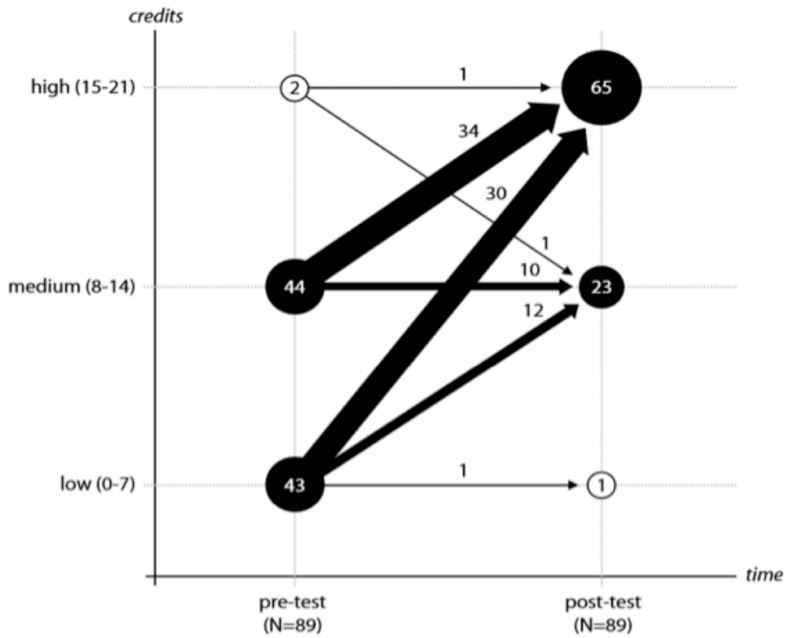

Figure 2. Pretest to posttest progression of categorized scores

Concluding remarks

In summary, we see that students' results improve between pretest and posttest, not only in total but also if we look separately at the three different building blocks: knowledge and skills application; creative scenario design; and critical scenario evaluation. Sustainability proves to be the trend most referred to in the tests. This may be so because earlier geography lessons paid attention to the human-environment relationship and the concept of sustainability, as they are at the core of school geography. Another reason might be that sustainability has been hot topic in Dutch society over the last few years. Low students' scores are found in creative scenario design in both the pretest and posttest. Indeed, most student scenarios appear rather one-dimensional. This might be related to the newness and complexity of the scenario design task: it is the most innovative element of the lessons as it requires the use of both knowledge and imagination. Some students, however, did create more substantial, interesting scenarios. This difference confirmed our interest in making a more in-depth analysis of students' scenario sketches of urban futures. We present the results of this analysis in the next section.

Results of the Analysis of the Scenario Sketches

In this section we present results which answer the second sub-question: *What combinations of prior geographical knowledge and skills, knowledge of trends, and imagination are visible in students' scenarios?*

For this qualitative analysis, we selected six sketches from those that students designed in the third lesson of the lesson series. We looked at the combined use of the first and the second building block: knowledge and skills application and creative scenario design. Since the phase of evaluation

comes after the sketching, the third building block of critical scenario evaluation is not included in this analysis. We analyzed whether the imagination is creative, which is the case if it is both novel –defined as surprisingly new – and effective, by serving a purpose (Bruner,1962; Cropley, 2001). First, we evaluate the three sketches with low scores, and then the three sketches with the highest score.

Sketches with a low score

Concerning imagination, the sketches with the lowest scores show elements that are probably intended to be novel but that already exist in current cities. Examples of this in Figure 3 are rainwater storage and urban farming. Other elements were novel, such as the jetpacks, with which students pictured themselves flying to school, enabled by new technology. However, although new, this concerns disconnected novelty, which is novelty that is not embedded in an urban structure or related to spatial developments.

Figure 3. Example of a scenario sketch with a low score

An urban spatial structure is missing in the low scoring sketches. Also, we see no integrated urban functions and features, such as a dense transport network, high-end shops and high-rise apartments. Students have not used prior geographical knowledge and skills. What we see are persons and disconnected objects, such as flying persons, houses, and a school (see Figure 3). Knowledge of trends is visible to a certain extent and related to different geographical dimensions. For example, in Figure 3 solar panels represent the trend of sustainability, referring to the natural dimension used in geography education. However, the trends and dimensions are not connected to other spatial scales (e.g. regional, national).

Although the sketches have many shortcomings, it is important to notice that they do show students' divergent thinking. For example, the jetpacks in Figure 3 do not illustrate unregulated self-expression, but they show the result of divergent thinking, also referred to as 'variability':

"doing things differently from the usual, regardless of accuracy, meaning, sense, significance or interestingness" (Cropley, 2001, p.14). Divergent thinking and variability are the first steps towards effective, creative imagination (Finke, Ward, & Smith, 1992).

Sketches with a high score

The three best-scoring sketches show creative imagination: divergent thinking that is both novel and embedded in an urban structure in which the elements are connected. The commercial drones highway in Figure 4 illustrates this. In one of the other high scoring sketches, students drew a park in the center of the city, instead of commercial functions, and defended their choice by referring to the importance of social cohesion. These are examples of the production of variability by building novel structures. Students' new ideas and their spatial implications express a narrative: they tell a story. Claiming the most expensive space in a city for a park expresses students' priorities and opens a perspective for new possibilities and different choices.

In the three best-scoring sketches, we see a spatial, urban structure with typical urban functions: for example, a university, high-rise buildings, or a business center. In Figure 4, the extra spatial layer in the air is connected to the urban structure, which shows awareness of a city as a system in which different dimensions – economy, nature, culture, politics – claim space. Other sketches use a map to illustrate spatial structure. The sketches also display relationships with other cities or spatial scales, for example by means of the 'international' business center mentioned in Figure 4. Students made use of their prior geography knowledge and integrated knowledge of trends in their sketches of urban futures: sustainability is for example part of Figure 4 by means of sustainable energy sources. Although this is encouraging, there is still room for improvement even in these stronger examples of scenarios: certain elements of the scenarios, such as the drones highway, can be questioned about their exact relevance, and it would be interesting to explore further dilemmas and contradictions within scenarios and between scenarios.

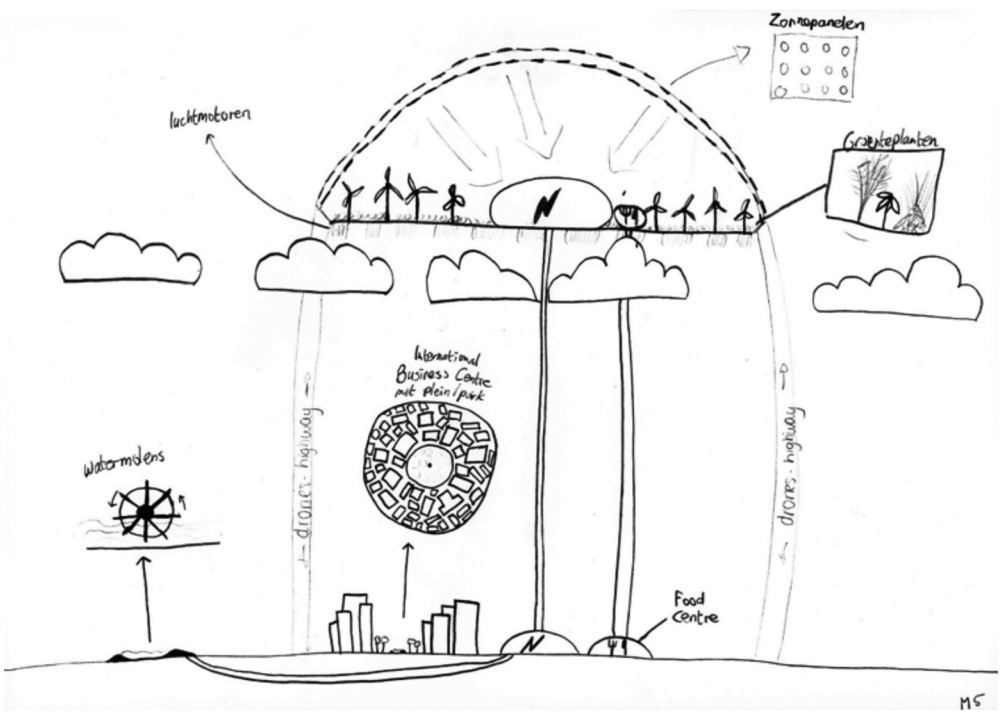

Figure 4. Example of a scenario sketch with a high score

Concluding remarks

In summary, in the sketches with the lowest score students are hardly able to combine imagination with prior geographical knowledge and skills. In the best sketches, students are able to combine imagination with systematic geographical thinking, making the novelty effective and thus creative. The best sketches pay attention to several urban functions, to spatial relationships in the city and the city's connections with other spatial scales and places, thereby showing aspects of a geographical approach (Solari, Solem, & Boehm, 2017; van der Vaart, 2001; van der Schee, 2007).

We end our analysis with a final remark about the Dutch school context. Formally, the Dutch geography curriculum offers possibilities for more creative learning activities such as sketching spatial changes. In practice, however, this is not common in secondary school geography. Most teachers direct the curricular freedom they formally have towards the high stake, final, central exams (Pauw & Béneker, 2015). Currently, these exams hardly include higher order thinking skills such as creativity. Where, for example, the French geography exams include the drawing of croquis, the Dutch exams currently lack such open, higher order thinking assignments.

Conclusion and Discussion

Introduction

In this paper, we have presented the results of a research study concerning students' scenario thinking on urban futures. Our main research question was*: To what extent are upper secondary school students able to think in terms of scenarios for urban futures?* In this section, we answer our research question in the conclusion and then briefly debate possible consequences in the discussion. We also consider the limitations of this present study and make suggestions for further research.

Conclusion

The results show that students' abilities to critically and creatively envision futures improve significantly: after the intervention, students were able to sketch and evaluate more and better scenarios. An improvement is in line with expectations. But what is encouraging is that this improvement took place in a short amount of time, in a regular school context although working with an approach that is very different from usual lessons. Also, the results show improvement for students departing from different starting levels, as shown in Figure 2. Our results can assist others in their attempts to practice the kind of critical and creative education pledged for by both geography educators and futurists (Hicks, 2012; Inayatullah, 2008; Krause et al, 2017; Lambert & Morgan, 2010; Roberts, 2013; Slaughter & Beare, 2011).

Although critical and creative thinking is visible in the students' results, the use of both knowledge and imagination could be developed further.

- Concerning knowledge and skill application, we saw that students easily picked up on the newly introduced trends which seemed to assist them in expressing ideas on tomorrow's cities. Also, once stimulated to use prior geographical knowledge and skills, most students were able to reason about how trends could work out globally, nationally and in a specific local spatial contexts. Scores on the knowledge and skill application questions more than doubled. A positive result, but these questions were intended to prepare for the main task, of creative scenario design.
- Concerning creative scenario design, we saw how students became more able to generate imaginative scenarios during the intervention, mainly by means of divergent thinking. This is an important result, given the newness of the explicit use of imagination in school geography and teachers' risk-averse pedagogy. Taking a 'risk' by using students' imagination enables teachers to better understand and appreciate students' perspectives on

futures. Based on personal perspectives, students' navigate, interpret and draw meaning from their environments (Hopwood, 2011). In scenarios we see these perspectives applied to future times in students' narratives for tomorrow's cities. Such narratives that encompass both imagination and knowledge can contribute to "'a sense of place': a feeling for the personality of a place and what it might be like to live there" (McPartland, 1998, p.346).

Although these first innovative steps are rewarding, students did not make all their divergent thinking effective: often their imaginative scenarios lacked embeddedness in a spatial context. The purposes of the newly imagined scenarios for urban futures were not always addressed. It appeared very complex for students to think about urban futures while using knowledge about the world as a system in which tomorrow's cities will have their place.

- Regarding students' capacities to critically evaluate scenarios we saw improvement whereby students showed an increased use of both knowledge and values in their argumentation. This indicates that students developed enough knowledge and also the skills to reason about futures from different perspectives.

In summary, the first rewarding steps towards envisioning futures have been taken: students are able to use knowledge and divergent thinking in scenario thinking. Improvement of the scenarios is possible, if students learn how to make better use of prior geographical knowledge to integrate divergent thinking into the spatial contexts of tomorrow's cities.

Discussion

Our conclusion suggests a stronger stimulus for students to use prior geographical knowledge and to think conceptually about futures. The participating teachers, who evaluated the lessons as relevant, practicable and challenging, also consider that more knowledge and systematic thinking should be used as the next step in students' learning process. For example: comparing Moses' focus on structure in New York's urban planning with Jacobs' focus on creativity, provides food for thought to students (Flint, 2011; Sennett, 2018) that can help them to deepen their thinking about scenarios. Everywhere there are local place and space issues with opposing interests and viewpoints. Examples of these issues can be discussed with students to help them bridge the gap between concrete, local experiences and a more abstract and systematical perspective.

Using more conceptual knowledge should, however, not reactivate the reflex to 'teach' futures. When the teacher provides only theoretical knowledge on tomorrow's cities by lecturing, students can easily switch to a "schoolwork mode" (Scardamalia & Bereitner, 2017, p. 66) and uncritically follow authoritative information to successfully perform the assigned task. Instead, scenario thinking needs active students, who can use knowledge and imagination to create scenarios. Fortunately, the use of mental images is not new to school geography (McPartland, 1998; Scoffham, 2013). To combine the teaching of new knowledge while at the same time providing scope for students' own thoughts is both a science and an art (McGee & Fraser, 2008). Scaffolding, the instructional strategy that can support this combination, starts with an intriguing design, and in class it requires high-quality feedback that stimulates thinking, imagination, and reflection. The teacher asks seemingly simple feedback questions, with no single answer, that trigger deep thinking and may start transformative learning (Illeris, 2007; Kelly, 2008; Mezirow, 1997) that challenges and changes our comprehension of the world as we know it. For example, in our research, students with fairly simplistic scenarios of urban futures were asked to outline how food supply would be organized in their envisioned future cities. This simple question triggered a thinking process about food production, transport, distribution, and waste. Thinking through these aspects of urban futures confronted students with taken-for-granted assumptions (such as: 'tomorrow's cities will have sufficient food supply') and activated them to develop more profound scenarios.

A final point of discussion concerns the assessment of scenario thinking. Assessing creative and critical thinking has been an explicit hurdle for teachers in futures education in school geography (Pauw & Béneker, 2015). In our research, we took two steps to gain more insight into evaluating scenario thinking. First, we used a test with authentic, open assignments that assessed critical and creative thinking. Second, we evaluated creativity in sketches through teamwork, as suggested in the literature on creativity in education, in order to support validity and reliability. If authoritative exams include assignments that assess higher-order thinking, this can raise the likelihood of teachers tacking up on their role in geography education that explores futures.

Limitations of the study

A limitation of the study is the relatively small number of participating students, which restricts the statistical power of our analyses. And, although an effect did probably occur after the intervention, there was no control group to check this, since there is no regular futures education in secondary geography education with which to compare our experiment. Our results might also have been influenced by the limited training time of the teachers who had to work with materials they had not developed themselves or used before. The series itself was limited to five lessons, which probably influenced the results of students. Finally, there might have been an effect of the pretest on the posttest performance. However, the marked degree of progression between pretest and posttest suggests that this it concerns more than a pretest effect.

Recommendations for future research

More experiments like ours are desirable, to increase insight into how students combine knowledge and imagination in critical and creative scenario thinking, and how we can stimulate this.

Supplementary research is also necessary on how students use reflection skills during scenario thinking: for example, when they evaluate preferred futures. The results from research on pedagogy for argumentative writing might be helpful, given the similarities between argumentative writing and scenario thinking, both of which are critical, creative and reflective processes. Research on students' argumentative writing shows how learning-through-observation was more effective than learning-through-practice (Couzijn, 1995; Rijlaarsdam et al., 2008).

A final recommendation for further research concerns the balance between the complexity of the real world and students' coping capacity. This is necessary because exploring futures can be intellectually and emotionally overwhelming (Kelly, 2005; Rogers & Tough, 1996). We saw students' emotions during scenario thinking, varying from enthusiasm to resistance. Future research could bring more insight into students' affective reactions and how these can contribute to constructive, empowering thinking about futures. For example in our research, some students results were so promising that a local authority invited students to present their ideas to the City Council. Futures education should aim for this kind of rewarding, empowering result.

Correspondence

Iris Pauw
Faculty of Psychology and Education
VU University Amsterdam
Boelelaan 1105, 1081 HV Amsterdam
The Netherlands
Tel: 0031 6 18550650
E-mail: i.pauw@vu.nl

References

Anderson, Lorin W., & Krathwohl, David R. (2001). *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.

Bateman, D. (2012). Transforming teachers' temporalities: Futures in an Australian classroom. *Futures, 44*(1), 14-23.

Bednarz, S. W. (2003). Nine years on: examining implementation of the National Geography Standards. *Journal of Geography, 102*(3), 99-109.

Bell, Wendel. (2001). Futures studies comes of age: Twenty-five years after the limits to Growth. *Futures, 33*, 63-76.

Bell, Wendel. (2009). *Foundations of Futures Studies, volume 1: History, Purposes and Knowledge*. New Brunswick: Transaction Publishers.

Béneker, Tine, Sanders Rickie, Tani, Sirpa, & Taylor, Liz. (2010). Picturing the city: Young people's constructions of urban environments. *Children's Geographies, 8*(2), 123-140.

Bijsterbosch, Erik, van der Schee, Joop, & Kuiper, Wilmad (2017). Meaningful learning and summative assessment in geography education: An analysis in secondary education in the Netherlands. *International Research in Geographical and Environmental Education, 26*(1), 17-35. doi:10.1080/10382046.2016.1217076

Bloom, B. S. (eds.), Engelhart, M. D., Furst, E. J., Hu, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: the classification of educational goals. Handbook 1: Cognitive Domain*. New York: David Mc Kay.

Botkin, J., Elmadjra, M., & Malitza, M. (1979). *No limits to learning: bridging the human gap*. Oxford: Pergamon Press.

Bruner, J. S. (1962). The conditions of creativity. In: H.E. Gruber, G. Terrell & M. Wertheimer (Eds.), *Contemporary approaches to creative thinking* (pp. 1-30). New York: Atherton Press.

Couzijn, M. (1995). *Observation of writing and reading activities: Effects on learning and transfer.* Dissertation University of Amsterdam.

Dordrecht: Dorfix. Cropley, Arthur. (2001). *Creativity in Education and Learning: A Guide for Teachers and Educators*. Oxon, United Kingdom: RoutledgeFalmer.

Dator, Jim. (2002). *Advancing Futures: Futures studies in higher education*. Westport, CT: Praeger.

Dator, Jim. (2009). Alternative Futures at the Manoa School. *Journal of Futures Studies, 14*(2), 1-18.

Dator, Jim. (2011). Futures Studies. In: William Sims Bainbridge (Ed.), *Leadership in Science and Technology,* (pp. 32-40). Thousand Oaks, CA: Sage.

Durance, Philippe, & Godet, Michel. (2010). Scenario building: Uses and abuses. *Technological Forecasting & Social Change, 77*, 1488-1492.

European Commission (2010). *Creativity in Schools: A survey of Teachers in Europe*. Luxembourg: Publications Office of the European Union.

Fairgrieve, J. (1926). *Geography in school*. London: University of London Press.

Finke, Ronald A., Ward, Thomas B., & Smith, Steven M. (1992). *Creative cognition: Theory, Re-*

search and Applications. Bradford, MA: MIT Press.
Flint, Anthony. (2011). *How Jane Jacobs took on New York's master builder and transformed the American city*. New York: Random House Publishing Group.
Gidley, J. M., Bateman, D., & Smith, C. (2004). *Futures in Education: principles, practice and potential*. Melbourne, Australia: Swinburne University.
Gidley, J. M. (2016). *Postformal education: a philosophy for complex futures*. Basel, Switzerland: Springer International.
Gough, N. (1990). Futures in Australian education: Tacit, token and taken-for-granted. *Futures, 22*(3), 298-310.
Guilford, J. P. (1950). Creativity. *American Psychologist, 5*(9), 444-454.
Hicks, David. (2006). *Lessons for the Future: The missing dimension in education*. Victoria, Canada: Trafford Publications.
Hicks, David. (2007). Lessons for the future, a geographical contribution. *Geography, 92*(3), 179-188.
Hicks, David. (2012). The future only arrives when things look dangerous: reflections on futures education in the UK. *Futures, 44*(1), 4-13.
Hopwood, Nick. (2011). Young people's conceptions of geography and education. In: G. Butt (Ed.). *Geography, Education and the Future,* (pp. 30-43). London: Bloomsbury Academic.
Illeris, K. (2007). How we learn: learning and non-learning in school and beyond. London/New York: Routledge.
Inayatullah, S. (2008). Six pillars- futures thinking for transforming, *Foresight, 10*(1), 4-21.
International Geographical Union, Commission on Geographical Education. (2016). *The International Charter for Geography Education*. Retrieved from: http://www.igu-cge.org/wp-content/uploads/2018/02/IGU_2016_def.pdf
Kelly, Patricia. (2006). Learning for Sustainable Futures: One Intervention. *Journal of Futures Studies, 10*(3), 1-14.
Kelly, Patricia. (2008). *Towards Globo Sapiens*. *Transforming Learners in Higher Education*. Rotterdam/Taipei: Sense Publishers.
Krause, Uwe, Béneker, Tine, Tartwijk, van, Jan, Uhlenwinkel, Anke, & Bolhuis, Sanneke. (2017). How Do the German and Dutch Curriculum Contexts Influence (the Use of) Geography Textbooks? *Review of International Geographical Education Online, 7*(3), 235-263.
Lambert, D., & Balderstone, D. (2010). *Learning to teach geography in the secondary school*. 2nd ed. Oxon, United Kingdom: Routledge.
Lambert, D., & Morgan, J. (2010). *Teaching geography 11-18, A Conceptual Approach*. Berkshire, United Kingdom: Open University Press.
Martin, F. (2011). Global Ethics, Sustainability and Partnership. In: Graham Butt (Ed.), *Geography, Education and the Future,* (pp. 206-244). London: Bloomsbury Academic.
McGee, Clive and Fraser, Deborah. (2008). *The professional practice*. Melbourne, Australia: Cengage learning.
McPartland, Michael. (1998). The use of narrative in geography teaching. *The Curriculum Journal, 9*(3), 341-355.
Newton, Douglas P. (2013). Moods, emotions and creative thinking: A framework for teaching. *Thinking Skills and Creativity, 8*, 34-44.
Mezirow, Jack. (1997). Transformative Learning: Theory to Practice. *New Directions for Adult and Continuing Education, 74*, 5-12.
Pauw, Iris. (forthcoming). *Envisioning Futures in School Geography*, PhD dissertation VU University Amsterdam.
Pauw, Iris, & Béneker, Tine. (2015). A futures perspective in Dutch geography education. *Futures, 66*, 96-105.

Pauw, Iris. (2015). Educating for the future: The position of school geography, *International Research in Geographical and Environmental Education, 24,* 307-324.

Pol, van de, Janneke. (2012). *Scaffolding in teacher-student interaction: exploring, measuring, promoting and evaluating scaffolding*. PhD dissertation University of Amsterdam. Amsterdam: Dutch Interuniversity Centre for Educational Sciences.

Roberts, M. (2013). *Geography Through Enquiry*. Sheffield: Geographical Association. Resnick, Lauren B. (1987). *Education and learning to think*. Washington DC: National Academy Press.

Rogers, M., & Tough, M. (1996). Facing the future is not for wimps, *Futures, 28,* 491-496.

Rijlaarsdam, G., Braaksma, M., Couzijn, M., Janssen, T., Raedts, M., Steendam, van, E.,Toorenaar, A., & Bergh, van den, H. (2008). Observation of peers in learning to write: practice and research. *Journal of Writing Research, 1*(1), 53-83.

Scardamalia, Marlene, & Bereiter, Carl. (2017). Two modes of thinking in knowledge building. *Revista Catalana de Pedagogia, 11*, 61-83.

Schee, van der, Joop. (2007). *Gisse leerlingen: geografische informatiesystemen, geografisch besef en aardrijkskundeonderwijs*. Amsterdam, the Netherlands: Onderwijscentrum Vrije Universiteit.

Scoffham, Stephan. (2013). Geography and creativity: Developing joyful and imaginative learners. *Education 3-13, 41*(4), 368-381, doi:10.1080/03004279.2013.819625

Sennet, Richard. (2018). *Building and Dwelling: Ethics for the City*. New York: Farrar, Strauss and Giroux.

Slaughter, Richard. (1996). *The knowledge base of Futures Studies,* Vols. 1-3. Hawthorn, Australia: DDM Media.

Slaughter, Richard. (2002). From forecasting and scenarios to social construction: changing methodological paradigms in futures studies. *Foresight, 4*(3) 26-31.

Slaughter, Richard. (2007). Futures Education, a gift for our times. *Learning Matters, 12*(1), 47-50.

Slaughter, Richard, & Beare, Hedley. (2011). *Education For The 21st Century, Revisited*. Queensland, Australia: Foresight International.

Standish, Alex. (2013). What does geography contribute to global learning? In: David Lambert & Mark Jones (Eds.). *Debates in Geography Education* (pp. 244-256). Oxon, United Kingdom: Routledge.

Steenbergen, van, Bart. (2005). The first fifteen years: A personal view of the early history of the WFSF. *Futures, 37*, 355-360.

Solari, Oslvado Muniz, Solem, Michael, & Boehm, Richard. (2017). *Learning progression in Geography.* Switzerland: Springer International Publishing

Toffler, Alvin. (1974). *Learning for Tomorrow: The Role of the Future in Education*. New York: Random House.

Vanolo, Albert. (2016). Is there anybody out there? The place and role of citizens in tomorrow's smart cities. *Futures, 82,* 26-36.

Vaart, van der, Rob. (2001). *Kiezen en delen, beschouwingen over de inhoud van het schoolvak aardrijkskunde*. Utrecht, The Netherlands: Universiteit Utrecht.

Veenman, Sietske, & Leroy, Pieter. (2016). Environmental outlooks: How they frame futures and long term uncertainty, *Futures, 82,* 63-75.

Wood, D., Bruner, J. S., & Ross, G. (1976). Role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 17*, 89-100.