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■ *Research Paper*

Complexity as a Big Idea for Secondary Education: Evaluating a Complex Systems Curriculum

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Over the past three decades, the study of complex systems has firmly established itself in the research and curricula of many universities around the world. This applies to both the natural and social sciences, and notably across disciplines. Complexity has a profound impact on the epistemology of science, and its place in education deserves reflection. The aim of our research was to explore how complexity might be introduced at a high school level and which knock-on effects such an introduction would have. Our initial findings suggest that complexity science can be made accessible for high-school students and that the resultant awareness can increase students' ability to engage in multi-disciplinary learning. An understanding of complexity arguably plays a crucial part in preparing students for their university education and for their role as stakeholders in deeply interconnected 21st century challenges. © 2018 John Wiley & Sons, Ltd.

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INTRODUCTION

There is not a single definition of complexity, but in a widely accepted description, Simon states that 'roughly by a complex system, I mean one made up by a large number of parts that interact in a non-simple way. In such systems, the whole is more than the sum of the parts …' (1991: 458). Most of the societal or ecological systems with which we interact are complex and their complexity is increasing (e.g. Homer-Dixon, 2011). Research centres and universities worldwide are recognizing this by investing more resources into better understanding and modelling of complex systems. Although Weaver (1948) wrote with much excitement about the importance of complexity science already 70 years ago, it has had little impact on schools to date. In the words of Nguyen *et al*. 'the emphasis in formal education is evidently placed on events, parts and isolated processes rather than systemic relationships' (Nguyen *et al*., 2011:2).

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Complex adaptive systems often develop in surprising ways and exhibit behaviour that cannot be understood or explained by applying reductionist methods (e.g. Weaver, 1948; Jacobson and Wilensky, 2006; Homer-Dixon, 2011; Colander and Kupers, 2014). The interactions between a complex adaptive systems' smallest parts result in global patterns that through feedback shape developments at a local level (e.g. Gell-Mann, 1994). Examples abound across disciplines and include bird flocking, the evolution of social norms or the spread of epidemics (e.g. Colander and Kupers, 2014). Complex adaptive systems can undergo sudden phase transitions, react disproportionately to small alterations or make consequences of past interventions apparent after unpredictable periods of time (e.g. Homer-Dixon, 2011).

Students can find complexity insights counterintuitive as their high-school education has overwhelmingly trained them in reductionist methods that favour linear causality. In line with others (e.g. Jacobson and Wilensky, 2006; Nguyen *et al*., 2011; Senge *et al*., 2012; Nguyen and Bosch, 2014), we argue that an explicit introduction to complexity science is paramount for high-school students as they make career choices and generally mature to become responsible citizens in an increasingly complex and interconnected world. This study examines one way of introducing young adults to complexity science, at a time when they are arguably 'old' enough to understand complex adaptive systems with some depth and sophistication, yet 'young' enough to develop the competence to evaluate when complexity models are essential, and when linear models suffice to illuminate an issue.

The authors have developed an introductory complexity module designed to be taught over seven blocks of 2 h. The teaching staff and some of the students at the Mahindra United World College in Pune, India, were involved in both the development of the module as well as the two pilot implementations. Based on their feedback captured through learning journals, questionnaires and semi-structured interviews, we iterated the module between pilots and drew conclusions that (i) underline the value of explicitly teaching complexity/systems thinking; (ii) make recommendations as to how complexity might be best embedded in the International Baccalaureate (IB) Diploma Programme in particular and a high-school curriculum in general; and (iii) outline questions for further research that arise from the pilot. This paper is timely, as the interest in teaching complexity at pre-university level is growing. The International School of Paris, for example, has recently changed its school mission to 'Educating *for* Complexity'. The curriculum developed for this research project is available under a Creative Commons licence, so as to enable school leaders and educators worldwide to build further experience.

In developing and deploying the complexity module, we were investigating possible answers to the following research questions:

1) What are the knock-on effects and benefits of introducing high-school students to complexity?
2) How should complexity be integrated into an existing high-school curriculum?
3) To what extent can high-school students apply complexity as a different approach to solving problems?

COMPLEXITY FOR SCHOOL IN THE LITERATURE

There is scant treatment of introducing complexity into the high school curriculum in the existing literature, although considerable work has been performed on introducing systems dynamics to younger grades (e.g. Clark *et al*., 2017). Starting with Jay Forrester himself (Forrester, 1993), there is a rich literature that discusses the application of systems dynamics in K-12 education (i.e. kindergarten through to grade 12) (e.g. Senge and Lannon-Kim, 1991). While mainly developing curricula on systems dynamics for his engineering students decades ago, Jay Forester also thought about the place for systems thinking in K-12 education (e.g. Forrester, 1994).

Systems dynamics and complexity coexist within a semantic field of complexity sciences. What these theories and concepts have in common is a 'focus on the whole system as well as

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its constituent parts and their interaction' (Nguyen and Bosch, 2013:105). However, complexity has become the more general term for the systems sciences, considering a wider class of systems with heterogeneous agents, advances in network science and emergent system behaviour. While teaching systems dynamics at elementary school level could well provide a fruitful basis for introducing complexity at higher levels, systems dynamics does not consider important other complexity characteristics included in complex systems as a more general and wider categorization of systems.

The literature on complexity theory and schools often looks at a school as a complex system and aims to offer advice to school leadership as to how to intervene or steer such a complex system (e.g. Morrison, 2002; Barnar, 2013; Shaked and Schechter, 2017). Considerable work has also been performed on analysing change and innovation in an educational context from a complexity perspective (e.g. Girtz, 2009; Goldman and Dec, 2017). Michael Fullan (1991) considers both the complexity of change and the issue of leadership in a complex system that is a school as well as an education system more broadly. Gabriele (2014) builds on his work to investigate the role of teachers in local and regional education systems change.

Another area of education where complexity theory is being used is the understanding of the learning process itself. Specific areas of application are the learning of foreign languages (e.g. Hiver and Al-Hoorie, 2016; Felipe Flores and Ubiratã Kickhöfel, 2017) and computer sciences (e.g. Gao *et al*., 2018). DeLeo *et al*. (2012) focus on the explicit teaching of complexity within the context of computer science, including a 'dramatic demonstration of complexity from simplicity' where 'each student becomes an element in a digital decoder, translating a binary number into its decimal counterpart, which then appears on an illuminated, seven-segment display' (2012: 48).

Xue *et al*. (2017) implement a 'cross-class multiple elective course' for the 10th graders in a secondary school for girls in Taichung, Taiwan, with the aim to develop their system thinking and problem solving ability. Students were encouraged to 'connect systems thinking with living and life', and included the development of the ability to ask questions, as well as experiential activities, case studies and issue analysis (ibid: 54). While this course explicitly introduces students to systems thinking, it is less comprehensive than the module analysed in this paper does.

Researchers have also investigated the extent to which an understanding for systems dynamics depends on age and other personal characteristics, finding that systems can be understood regardless of age (e.g. Booth Sweeney and Sterman, 2001). Project Growing Up Thinking Scientifically, initiated at the Santa Fe Institute and currently at MIT, is an extensive effort aimed at introducing modelling complex systems in elementary and middle schools (Lee *et al*., 2011). While the programme has been deployed at various schools, the approach is strongly focused on computational learning in the context of Science and Technology education. Acknowledging computational tools as an important component of learning about complex systems, our curriculum focuses in particular on the introduction to network theory and agent-based modelling as important tools to develop an understanding of complexity in both science and society.

Jacobson and Wilensky (2006) provide a comprehensive discussion of both the importance of complex systems for education and the implications for the learning sciences. They draw attention to the fact that there are challenges both with regard to the 'learnability' of complexity and also that it raises issues with approaches to learning itself. Notwithstanding these challenges, they underscore its epistemological impact, concluding with Proust: 'The real voyage of discovery lies not in finding new landscapes, but in having new eyes' (as cited in Jacobson and Wilensky, 2006:29).

APPROACH AND RESEARCH METHODOLOGY

A Practical Approach to Introducing Complexity

There is no straightforward way of introducing the study of complex systems into an existing

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high school curriculum. The existing disciplines often already include some elements, in particular in biology, the social sciences and philosophy. There is however no commonly used language or any cross-reference that would allow students to connect the dots to form a conception of complex systems. Singh and Qi (2013) explore the concepts of global mindedness, a key pillar to an IB education, with reference to complex concepts such as cultural pluralism, efficacy, global centrism and interconnectedness. In discussions with the curriculum developers at the IB, several alternatives were considered: (i) inclusion in the subject of Theory of Knowledge (TOK), an epistemological course that is compulsory for all IB Diploma Programme students; (ii) gradual introduction into each discipline in the curriculum review cycle; (iii) integration into the IB teacher resources for 'Approaches to teaching and learning'; and (iv) finally an add-on module.

Each option has advantages and drawbacks, associated with practical issues such as timing, governance or teacher competence. The choice was made to develop and test an add-on curriculum. This challenged schools to find space on their roster, but it presented the advantage of allowing an evaluation of the impact of the curriculum module on its own. While such an add-on complexity curriculum is not considered a necessary end state, it is a useful stepping stone that allows first research into possible answers to the questions of impact, implementation and application.

Description of the Curriculum

The module consists of seven 2-h sessions, including experiential learning, illustrative applications, conceptual learning and individual reflection. A short summary of the sessions is the following:

Unit 1—Complex systems
Using the core example of the Tragedy of the Commons as analysed differently by Hardin and Ostrom, students are introduced to the dynamics of systems and how framing them as either a complex system or not, changes the analysis. Including some

(*Continues*)

experiential simulations, this is essentially an introductory unit.
Unit 2—Complex or complicated
This unit introduces some of the key concepts: learning to distinguish between a complicated and complex system, understanding the concept of emergence and exposure to terms such as 'wicked problems', 'resilience' and 'adaptivity'.
Unit 3—Systems dynamics
Some students may have had an introduction to systems dynamics, which forms a useful foundation for complexity. In this module, they learn various intervention strategies in a system and are introduced to concepts of stocks/flows, time delays and feedback. The consequences of the choice of a representative agent with average properties is discussed.
Unit 4—Networks
This unit gives an understanding of networks as a way of conceptualizing complex systems. It provides basic network theory (nodes, edges, types of networks) and introduces the concepts of phase transitions, small-world networks and scale-free networks.
Unit 5—Why model?
Netlogo is used to give students hands-on experience with simulation through agent-based modelling and an appreciation that there is no 'solution' to a complex systems problem. Sugarscape provides a canonic example of agent-based modelling for exploring a societal issue such as economic inequality.
Unit 6—Connecting to student's project
The purpose here is to integrate the content of the module with a student's individual project at school. It encourages the articulation of their project in the language of complex systems (agents, emergence, networks, resilience, modelling, phase transitions, tipping points, non-linearities …). They subsequently experiment with different ways of mapping systems, ways of identifying 'catalytic' nodes and interventions.
Unit 7—A crude look at the whole

Integration and looking back on the module as a whole: Can students understand when ignoring complexity is a problem but also what the limitations of our knowledge of complex system dynamics are? Have they acquired the ability to bring a complex systems perspective to bear on problems of real societal importance?

Methodology

The module offering as well as the research purpose was introduced to all students at the beginning of the academic year. Participation was on a

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voluntary basis and included appropriate consent for research purposes.

The module was taught twice by the authors, first in November 2016 to a group of 33 students and then in April 2017 to a group of 10 students. The November module was oversubscribed, but 33 was the maximum class size considered effective to test the module. In April, other important tasks in the school year, such as essay deadlines and other tests, competed with the complexity course, so that only 10 students were able to participate. The limited size of the pilot and its specific educational context encouraged an action research approach, beginning with the intervention and then capturing changes that might be causal or correlated. Cohen and Manion (1994) attest that action research methods are particularly suitable for limited interventions or innovations being introduced into an existing system. The ambition was to teach the module and examine what changed as a result in the students' perception of the world, the quality of questions they ask of challenges or their way of approaching problems in general.

To evaluate changes and capture the added value of the intervention, participating students were asked to keep a learning journal for their reflections throughout the module. After each session of the module, the students were given 10 min to reflect on their learning in writing, guided by three questions: What have you learned? What have you found surprising? Which questions do you now have?

In addition to these journal entries, the authors held focused interviews with a limited subset of participants. These interviews were held with three students who had participated in the first course, when the second course was being held, that is, 5.5 months after they had participated in the course. This distance in time to their course experience allowed reflections about potential longer term impacts of learning about complexity.

This qualitative data were then complemented by a survey (Table 1), which yielded quantitative patterns that are discussed in the findings. The survey focused on the first two research questions, asking students to consider the general relevance of their gained understanding of complexity and how they would recommend including such learning in the IB Diploma Programme.

Lastly, we wanted to capture a potential shift in thinking when approaching complex challenges. Ritchhart and Perkins (2008) have developed methods of making students' thinking visible, encouraging any process that 'documents thinking for later reflection' (2008:58), such as

Table 1 Student survey questions

1—The complexity course is relevant to my UWC, united world colleges education:				
Not at all	Somewhat	Neutral	A lot	Very much
2—The complexity course is relevant to my UWC education:				
Easy	Less than average	Average	More than average	Challenging
3—The length of the complexity course was:				
Too short	A little short	Just about right	A little long	Too long
4—The complexity course is relevant in the following disciplines (select multiple options):				
TOK	Mathematics	Psychology	Comp. Science	Fine Arts
Economics	Global Politics	Biology	Language & Lit.	Other (specify)
Physics	History	Chemistry	Performing Arts	
5—In your opinion, complexity is best taught (multiple answers possible):				
As a separate introductory course (as you experienced)				
Integrated in TOK (*Theory of Knowledge*)				
Integrated in each of the disciplines you selected above				
Integrated in Triveni (*individual project*)				
Other (please specify)				
6—In which course did you participate?				
November 2016 or April 2017				
7—Can you give an example of how this course as changed your way of thinking?				

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speaking, writing and drawing. These methods have been shown to have high intrinsic value (ibid), with the additional benefit of creating useful documentation for research purposes. We thus designed a simulation exercise that consisted of a cityscape with the question: 'What would a good life in a city be like?' (Figure 1). In response to this purposefully broad and open question, students could draw into the sketched cityscape as well as respond to prompts on the side, asking specifically about education, employment, energy and ownership: 'What would this be like? What would have to change?' All students participating in the intervention worked in pairs or groups of three to address the question.

To compare the impact of the module, control groups were recruited from the same class each time, including 10 students in November 2016 and 15 in April 2017. In November, seven groups who had taken the course (T groups) participated in the final exercise, and five N-groups, that is, non-takers. In April, there were four T groups and six N-groups.

The student population was characterized by its diversity in national and cultural background, with one quarter coming from the Indian subcontinent. More than half the students had English as their second or third language.

Students worked in groups of two to three to respond to the task over 30–45 min. We then analysed their responses, categorizing emerging patterns and looking for potential similarities and differences in the quality of response between the students who had taken part in the complexity module and those who had not (control group). The papers were all laid out on the ground and had been marked with 'T' (taker)

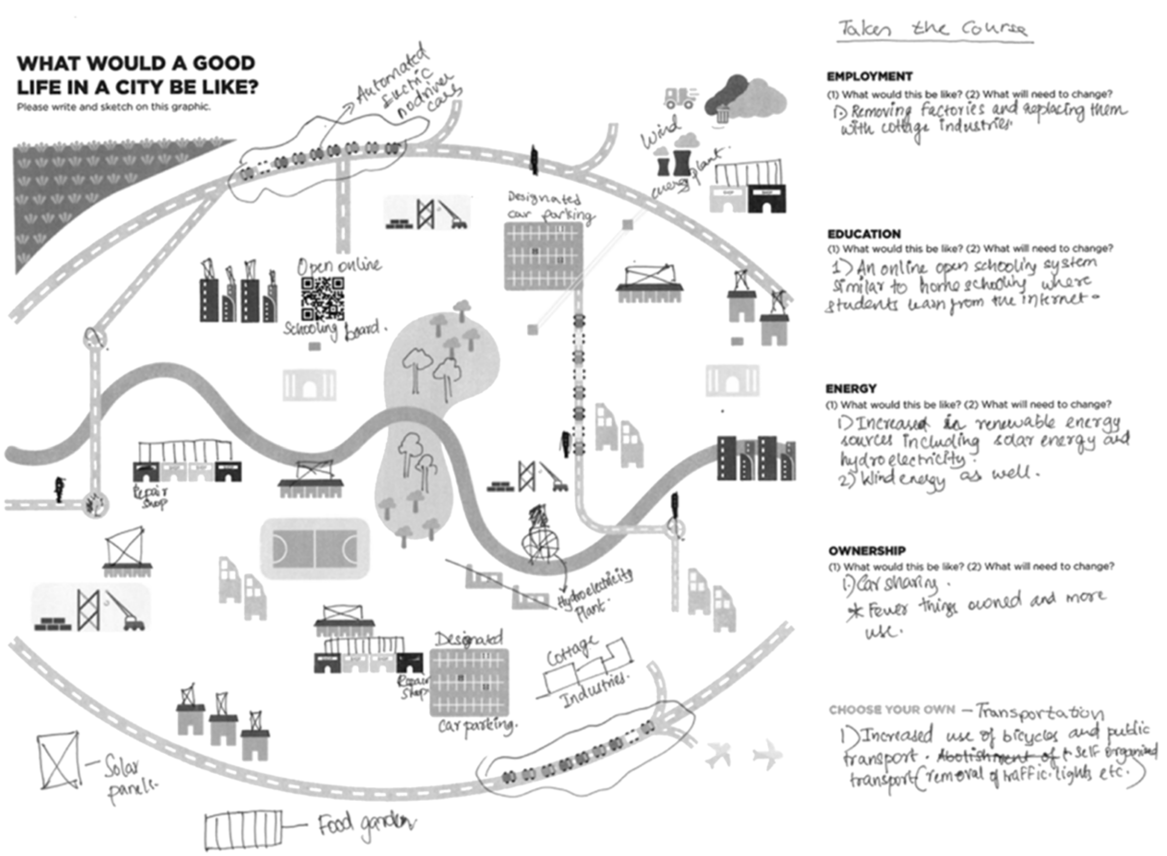

Figure 1 'What would a good life in a city be like?' printout of the post-module immediate evaluation exercise

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or 'N' (non-taker) on the backside, which was not visible to the researchers analysing for patterns. In silence, first two individual researchers (including one of the authors) looked for patterns independent of each other and then discussed their findings. A third person was also asked to look for patterns independently to confirm or reject the findings and their interpretation by the first two.

Like in all educational contexts, the specificity of the student body and the school necessarily puts limitations on the ability to generalize the conclusions from the described data collection methods. By publishing the full curriculum, we would like to encourage and enable educators globally to test the curriculum with their own students. It can be accessed under the following link: https://www.ellenmacarthurfoundation.org/assets/downloads/schools-colleges/An-IB-complexity-module-for-the-Diploma-Programme-15.11.17.pdf

FINDINGS AND EVALUATION

As described above, the impact of the module on students was evaluated in four ways: (i) through a survey (with a response rate of 40%); (ii) through a simulation exercise performed simultaneously by students who had participated in the module and a control group; (iii) through structured interviews with a limited number of students 5 months after the module; and (iv) through student journals that both the November and April cohort were asked to keep to capture their insights, comments, questions and other reflections. Twenty-three students submitted the latter in November, eight in April. With the use of this data, the initial research questions could be addressed as follows:

What Are the Knock-on Effects and Broader Benefits of Introducing High-school Students to Complexity?

A survey was completed by 18 students. From the comments, we see that students who had participated in the module found the module helped them see and tackle problems in a new way. They saw many opportunities to apply the module's concepts and tools in their chosen IB Diploma subjects. Seventy-seven per cent of the survey respondents responded positively to the statement 'The complexity course is relevant to my UWC education'. Seventy-eight per cent found the course content not more challenging than the average subject matter. The interviews with the students confirmed that the module had shifted their approach to problems; they stated that they were now actively looking for interconnections, rather than assuming them away. They were able to quote examples from multiple disciplines ranging from biology to literature demonstrating how the module had enabled them to ask different questions. In several cases, they were able to cite how they found connections with daily events, such as a TV programme that features epidemiological investigations. They also valued the discussion of complexity models in subject lessons. One student, for example, had been asked to make a presentation on complexity economics in their economics class.

Apart from the ability to recognize complexity concepts in everyday life, another knock-on effect of the module was that students seemed encouraged to critically engage with their own assumptions and worldview. A pattern that emerged from the analysis of the student journals shows that students generally after the first and second unit experienced a sense of confusion about their own worldview and how complexity would fit in with the other methods, concepts and paradigms they had been presented during their schooling. The following quotes are illustrative of similar questions that eight students shared after the second session of the module: 'Why do we have to study and strive for efficiency?'; 'Why are human beings so fixated on figuring out uncertainty?'; 'Why can't we let uncertain things in life be?' These questions can be seen as indicative that at least one third of participating students in November engaged critically with the shift in perspective as a result of being introduced to complex systems. Other students also shared their struggle in linking their learning about complexity in relation to their previous knowledge, as the following quote illustrates: 'I'm still having

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trouble about the emergence of a system. Is that like an output of the system that later becomes part of it? When is a complex system "predictable"?'

A related knock-on effect of the module seems to be that students gain a new perspective on and approach to societal challenges. The following student's reflection is typical of general feedback given through the survey, outlining that the module allowed them to view issues presented in their school education in a new way:

> I tend to think more of systems as complex rather than complicated, for instance, I currently see that although disciplines are taught separately and have different foundational approaches, they are all interconnected. You cannot do one without the other, which is especially evident for me, in the natural sciences. I think that I am becoming more aware of the fact that nothing in fact happens in a linear progression, but in flux wherein exists a complex web of stakeholders, cause and effects etc.

Other than sketching this general metacognitive pattern, the journal entries are artefacts of individual learner journeys, defined by a student's personal background, talent profile and context. As with most topics, there were some students who still grappled with the relevance of complexity science in the end: 'Although I have been able to understand and process the information in this course, I am still clueless on how this is applicable to my learning in general'. However, as supported by the survey results and interview responses discussed earlier, the majority of students found an introduction to complexity illuminating, stimulating and a useful addition to their education.

How Should Complexity be Integrated into an Existing High-school Curriculum?

The dominant opinion expressed by the students in the survey was that complexity should be introduced as a separate, stand-alone short course and should then be highlighted and embedded in all relevant subjects. It was striking that students found the module relevant to all their subjects, spanning from fine arts (20% of survey responses) to TOK (95% of survey responses). The scores were widely distributed with somewhat more emphasis on the social sciences such as geography, the humanities and also to biology. Math and physics lagged behind somewhat, possibly due to the specific choice of examples used in the module. Nevertheless a majority (55%) expressed a preference for a stand-alone complexity module.

Although half the students responding to the survey found the 14-h format short or very short, 50% of the respondents advocated for the model to be taught as one of the units of TOK. Only a third thought the curriculum should be primarily taught as part of the traditional school disciplines. During the focus interviews, students also valued that the module was taught as a stand-alone course, additional to the standard disciplines, as they worried that it would be hard to integrate and overcome the inherent reductionist biases that are embedded in many school programmes.

The student feedback suggests introducing students explicitly to complexity in an additional course at the beginning of their high-school time and then explicitly practicing an application of complexity within the various disciplines. This option should then be validated through further research.

To What Extent can High-school Students Apply Complexity as a Different Approach to Solving Problems?

It was beyond the scope of our study to shadow students over a longer period of time to observe how and when they would apply complexity as a different approach to problems they encounter or think about. One could also argue with Proust that high-school education should primarily provide students with a new lens to the world. Considering both, we used the simulation exercise as a proxy.

The module appeared to heighten students' ability to see interconnections between different factors and elements of an ecosystem, such as a city. We deduce this from the finding that students who had taken the module (takers—T)

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used arrows more frequently to illustrate interdependencies between different aspects of the cityscape. Two T groups (i.e. four students) even asked for an additional piece of paper to draw a systems map. Control groups (non-takers—N) were more prone to crossing undesirable elements out and putting them outside the city boundaries, for example, landfills. It is also noteworthy that two T groups created definitions for a 'good life' in a city and focused their work in that way, while all other groups completed the tasks without making their interpretation or definition explicit.

The N-groups responses could generally be interpreted as indicative of a linear understanding of progress and development, often simply 'adding' more of the elements they enjoyed, for example, malls, sports facilities. T groups on the other hand tended to focus on 'smaller scale' developments, such as introducing repair shops, local responses to potential challenges. This suggests that the complexity curriculum provided students with an experience of complex adaptive systems and how these need to be approached differently to 'linear or simple issues'. T groups displayed a higher sensitivity for the system as a whole and were aware of where they drew the boundaries of the system. It also suggests that students developed an understanding as to when ignoring complexity may be restrictive.

Another way in which students seemed to integrate an understanding of complexity in their approach is through a heightened sensitivity to the interconnectedness of the world and the compounded causality underlying events. When responding to the prompts about what education, employment, energy and ownership would be like in the simulation, N groups generally approached their responses through the lens of familiar political ideologies, making reference to communism, socialism and capitalism. T groups on the other hand did not refer to any political ideologies at all, but rather focused on the interdependence between the categories as well as local changes, 'bottom up approaches' and collaborations. The students tended to solve local issues by focusing on the interdependence between different agents or factors. This suggests that complexity could be a powerful element for citizenship and social sciences education such as politics or geography. This paper merely highlights this unexpected finding and suggests further research into the relationship between an understanding for complexity and an approach to sociopolitical issues.

In journal entries after unit 5 to 7, students expressed excitement about applying their understanding of complexity to challenges they find interesting or are facing themselves. They started to think beyond the end of the module, mapping thoughts and reflections of how to take their own learning journey forward. At this point, they wrote reflections such as 'I really appreciate the beauty of models and its effectiveness in helping us understand the effects, although we cannot predict them'. Another student writes: 'I am so excited to continue exploring and manipulating NetLogo models. I wish they were used more in education, not just in teaching about complexity but in science and social sciences classes'. This suggests students came to embrace complexity as a different way of solving problems and began to question their wider educational experience with a complexity frame in mind. This shift in perspective was not just evident throughout the module, but seemed to be lasting as shown through the surveys and in the interviews.

CONCLUSION

As complexity science becomes embedded in university research and curricula worldwide, it is often first adopted in Master programmes and at PhD level. It is rarely integrated in undergraduate programmes (Colander and Kupers, 2014). Even though parts of the content of the complexity module discussed here were derived from a Masters course, the pilot participants (i.e. high-school students) demonstrated understanding and application of the key principles of complexity to solve problems. Despite the specificity of the educational context and the small sample size, the evidence of this study suggests that learning about complexity and applying its tools to solve problems is accessible to high-school students.

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This understanding of complexity has also had knock-on effects on their understanding of how different subjects and disciplines can interact in examining complex issues. An introduction to complexity can thus support interdisciplinary and project-based learning, drawing on inquiry-based pedagogy. Once students have been introduced to complex systems science more generally, teachers in discrete subjects can integrate such understanding by, for example, changing their instruction style from structure centred to function-centred as suggested by Homer-Dixon (2011) in order to support the interdisciplinary learning. As became apparent through the analysis of the journal entries, being introduced to complexity can bear many metacognitive insights for students as learners, questioning their current worldview and ways of solving problems.

While our expectation had been that integrating complexity into the disciplines would be most effective, many students felt that it was useful to be explicitly introduced to complexity in a stand-alone short module, as it would enable them to first gain the understanding and vocabulary to then discover complexity in all subjects and disciplines they study. Such an introduction would enable them to apply their understanding when engaging with 'real world' challenges, which will further advance their comprehension.

As was suggested by students in surveys and interviews, there might be a good fit for teaching complexity through the IB TOK course or an equivalent philosophy course. Additionally, a range of subjects, such as geography and Environmental Systems and Societies already have many obvious links to complexity in the existing curriculum.

UWC Mahindra College will build this curriculum into its TOK curriculum as part of its broader 'Peoples, Nations and Cultures' course, staff expertise allowing, as identifying teachers comfortable with this interdisciplinary approach has been a challenge. The college staff have also identified complexity science as an essential foundation for the World Studies Extended Essay, a compulsory independent study project that requires students to approach a problem or challenge with reference to at least two different disciplines. The complexity module can thus be used to prepare the students for this interdisciplinary work.

The education system itself being a complex adaptive system, bottom-up experiments such as this one are an essential part of the change dynamic. Building on the insights from scaling such experiments, complexity could be integrated into curriculum standards. This initial research will hopefully encourage many more high schools to experiment with introducing complexity into their curriculum and adding more evidence to the necessarily limited scope of this research project.

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