



A Cross-cultural, Cross-age and Cross-gender Study of Hong Kong and UK Secondary Students' Decision Making about a Biological Conservation Issue

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Abstract

The possible roles of culture, gender, and age-related factors as mediators of decision making about socioscientific issues (SSIs) have been underexplored, particularly the impact of cross-cultural interactions distinct cultural groups' perspectives. This comparative study explored culturally influenced decision-making using a mixed methods approach. To study the impact of culture and cross-cultural understanding on students' decision-making, and how these impacts are possibly mediated by age and gender-related variables, 106 11-13 year old students and 60 15-17 year old students from three Hong Kong schools and four UK schools were engaged in decision-making about shark fishing, framed as an SSI. Data were collected on how students make decisions about the issue before and after interacting with their own peers and considering the views of their international counterparts, using discussion records, supplemented with focus group interviews. The findings show that students associated with the culture of shark eating do not necessarily identify with shark fishing. Three dimensions characterize students' decisions: the human activities to be controlled, the ways to address issues arising from shark fishing, and the concerns underlying students' decisions. Although students showed support for conserving sharks, there were nuanced differences between the two cultural groups in the three decision dimensions, which were possibly mediated by gender and age factors. The findings provide support to the impact of cultural exchange through cross-cultural presentations, post-activity discussion and reflections on their own and others' views on broadening students' perspectives and stimulating their critical reasoning. The study raises some important questions relating to group decision-making about shark conservation.

Introduction

Socioscientific issues (SSIs) are playing an important role in science education as evidenced by the increasing research on students' capacity to engage in decision-making about SSIs. Such ability is regarded as an important part of scientific literacy to allow students to engage "intelligently in public discourse and debate about matters of scientific and technological

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3 concern” (NRC, 1996, p. 13).
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7 Research indicates that students’ various abilities and values underlie the reasoning process
8 behind decision-making about SSIs. These include multi-perspective thinking and science
9 conceptual understanding (e.g., Ratcliffe, 1997; Hogan, 1999), evaluation of evidence (e.g.
10 Sadler, et al., 2004), values and moral or ethical judgement (e.g. Sadler and Zeidler, 2005), and
11 generation of criteria to differentiate among alternatives (Authors, 2012).
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17 Research findings on students’ abilities to reason about SSIs are mixed. While some researchers
18 have found that students are able to recognize arguments from social, ecological, economic and
19 scientific perspectives (e.g., Patronis, et al, 1999; Wu and Tsai, 2007), others have shown that
20 students do not intuitively address environmental SSIs from multiple perspectives (e.g., Hogan,
21 2002; Kortland, 1996). Although variation in the development of epistemological beliefs in SSIs
22 is recognized (Zeidler, et al, 2013), the vast majority of research studies have been targeted at a
23 particular age group drawn from middle school to college students as evident in Sadler’s review
24 (2004). A rare example of a singular study involving subjects of different ages was undertaken
25 by Eggert and Bögeholz (2010), who reported that decision-making competence increased with
26 years of education in terms of the use of trade-offs and the ability to weigh decision criteria.
27 There have been more studies on the effect of gender on learning with SSIs than the effect of age.
28 For example, Ottander and Ekborg (2012) reported that girls were more interested in discussing
29 SSIs and considered they learned more through SSIs, which was relevant to their future. Yang
30 (2004) found that in making decisions on environmentally related SSIs, female high school
31 students stressed human feelings more than males, while males tended to emphasise the
32 importance of experts’ information to a greater extent. However, Wu and Tsai’s (2007) study on
33 the use of nuclear energy, observed no gender differences in terms of construction of supportive
34 arguments, counter-arguments and rebuttals. It is unusual for studies on decision-making about
35 SSIs to compare different gender or age groups in a single study - let alone possible interactions
36 between the two, leaving a gap to be filled in this field of research.
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53 Recognizing decision-making about SSIs as an important means to develop students’ scientific
54 literacy (Liu, et al, 2011) and character and value development (e.g. Lee et al, 2013), researchers
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3 have turned to exploring pedagogical approaches to enhance these processes in the classroom.
4 These approaches include group discussion and cooperative learning (e.g. Day and Bryce, 2013;
5 Maloney, 2007; Author, 2009), strategic training in decision-making strategies (Gresch et al,
6 2013), using optimization as a reasoning strategy (Papadouris, 2012), transactional
7 argumentation analysis (Rudsberg, K. et al, 2013), and the use of ingenious discussion strategies
8 for widening discussion perspectives (France et al, 2012). Despite this, studies on the influences
9 of cross-cultural interactions on students' decision-making are not common, even though many
10 of these issues transcend national boundaries and necessitate international cooperation for their
11 eventual resolution. We refer to cross-cultural interactions as different forms of exchanges that
12 expose students of a particular culture to the views of their counterparts of other cultures, which
13 may vary from merely learning about these counterparts' views to negotiating with them ways to
14 address the issue in question. This implies the fundamental importance of including a cultural
15 perspective in deliberating SSIs. The lack of emphasis on the influences of cultural contexts in
16 relation to decision-making about SSIs, and the effect of cross-cultural exchanges as a
17 pedagogical approach to enhance students' decision-making on SSIs, does not reflect the real life
18 situation in which consensual decisions underpinned by intercultural understanding are essential
19 to resolving global SSIs.
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34 There are a few studies that point to the potential influences of cultural contexts on secondary
35 school students' decision-making. Authors (2012) explored the influences of contexts on
36 students' decision-making, by comparing how 13-14 year old students in two cities of
37 China – Hong Kong and Guangzhou - differed in their decisions about the issue of whether to
38 impose central slaughtering of chickens to control the spread of avian flu. The results showed
39 marked differences between the two student groups in their decision-making criteria, with Hong
40 Kong students being more concerned with health risks, and Guangzhou students more concerned
41 with maintaining traditional Chinese culture. Moreover, the study revealed that multi-perspective
42 reasoning was enhanced by both intra-contextual class discussion within the same school in each
43 city, and cross-contextual interactions through watching and considering video-recorded
44 presentations of the decisions of peers in the other city. The outcomes indicate more complex
45 decision-making characterized by a greater degree of compromise between conflicting
46 alternatives.
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5 Beyond contextual influences to cultural influences, Zeidler et al (2013) conducted a study
6 across five different countries exploring culture as a mediator of students' epistemological
7 patterns of reasoning about SSIs. The findings demonstrated cross-cultural congruity in students'
8 conceptualization of fairness in making decisions about the allocation of medical resources, but
9 disparities existed in students' ability to raise scientifically appropriate questions and make use
10 of scientific information to assist them in making decisions.
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17 More recently, Author (2015) conducted a pilot cross-country and cross-cultural study to
18 compare how 16-17-year-old students in England, Germany, Sweden, and Hong Kong engaged
19 in group decision-making about whaling. The findings showed that the Hong Kong students
20 were more tolerant of whaling than their English and Swedish counterparts, with the former
21 putting a dual emphasis on economic and scientific perspectives, whereas the latter focused
22 mainly on scientific and ethical perspectives. The authors postulated these outcomes were due to
23 different cultural contexts, resulting in culture-dependent value judgments.
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31 This study aimed to expand our understanding of cross-cultural decision-making about
32 conservation issues. We set out to explore the possible role of culture, as a mediator of SSI
33 decision-making by secondary school students, and the impact of cross-cultural interactions on
34 the quality of decision-making about shark conservation. Shark conservation has aroused
35 increasing concern as the increased consumption of sharks, particularly their fins, due to rising
36 living standards in Asian countries, has posed a threat to their continued survival. To the best of
37 our knowledge, there have not been cross-cultural studies of this kind that have examined the
38 influence of age and gender on students' decision-making about conservation issues, and how
39 these variables interact with culture in influencing decision-making. A further factor investigated
40 is the effect of differential cultural connection of the issue on students' decision-making. The
41 study also examined the impact of knowing other cultures' views on one's own final decision.
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51 Research questions

- 52 1. What effect does culture, age and gender have on students' decision-making about shark
53 fishing?
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3 2. What impact does an activity involving group discussion and cross-cultural understanding
4 have on students' decision-making about shark fishing?
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8 **Methodology**

9 *The participants*

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12 Secondary school students in Hong Kong (HK) and the United Kingdom (UK) were selected as
13 the subjects of the study. The first two authors extended invitations to schools in their locations
14 to take part in the study in HK and the UK respectively. It was up to the teachers to select the
15 classes for participation in the study such that there was minimal interference to their teaching
16 schedule. The students were aged 11-13 and 15-17, and are referred to as the junior and senior
17 group respectively. The junior group comprised 2 classes with 59 HK students and 2 classes with
18 47 UK students; and the senior group comprised 2 classes with 43 HK students and 2 classes
19 with 17 UK students. All the eight classes were from secondary co-educational and public (state)
20 schools. The four classes in Hong Kong were from three schools and the four classes in the UK
21 were from four schools. Most students were average to higher ability in science. The UK
22 students were of mixed ethnicities with very few ethnic Chinese, while the Hong Kong group
23 was ethnic Chinese, which made up about 98% of the population of the territory. As the sample
24 was necessarily small, the findings were intended to provide insights into our research questions,
25 generating hypotheses worthy for further study. Each class in each school was paired up with a
26 corresponding class of comparable age in the other locality for cross-cultural exchange. Prior
27 consent was obtained from the school, parents and students before the activity, to comply with
28 the ethical requirements of both locations.
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43 *The issue*

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45 Shark fishing as a conservation issue was chosen as the focus for discussion and decision-making.
46 Shark fishing is more culturally and economically related to Hong Kong than UK. Shark fins are
47 regarded by the Chinese as a traditional delicacy, commonly consumed on special occasions such
48 as weddings or birthday banquets (Fabinyi, 2011), and it can therefore be regarded as more
49 culturally related to HK students than to UK students, although Europeans sometimes
50 unknowingly also consume a certain amount of shark meat (Friedrich et al., 2014). This has
51 become a global conservation issue as sharks are hunted all over the world and many shark
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3 species are declining, threatening their survival. It is increasingly recognized as a problem to
4 which actions such as removal of shark fins from the menu by some HK restaurants have been
5 taken to address the issue. Hence, it is envisaged that this issue might elicit different responses
6 from students in the two locations due to the different cultural relevance of the issue.
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10 11 12 *The decision-making framework*

13 In this study, students were encouraged to consider and discuss what should be done about the
14 shark fishing issue through a series of scaffolds. They were first introduced to the issue by
15 providing them with rudimentary facts about sharks and shark fishing with a short video showing
16 the causes and existing status of the issue, but without any suggestion of what actions need to be
17 taken. The same video and information about the issue were provided to all participants
18 including junior and senior ones from both locations. After this, they were asked to consider
19 arguments and evidence relevant to the issue. Secondly, students were asked to discuss the issue
20 in groups as guided by the framework postulated by Svenson (1992, 1996), in which they
21 *identified decision alternatives, differentiated those alternatives by weighing the pros and cons,*
22 *and made the group's decision with justifications.* The third phase adopted the idea of
23 *post-decision differentiation*, engaging students in continuous evaluation of their decisions by
24 drawing on the decisions of their international counterparts from the UK or HK. However, no
25 joint decision-making between the two cultural groups was involved due to time constraints.
26 There were altogether 25 student groups in all the HK schools, with 14 and 11 from the junior
27 and senior classes respectively; and 18 groups on the UK side, with 12 from the junior and 6
28 from the senior level.
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43 *The research design*

44 Research question 1: A mixed methods approach was used to answer research question 1 to
45 identify patterns and trends in students' decision-making with respect to cultural, age and gender
46 comparisons. The feasibility of this approach has been demonstrated in previous studies (e.g.
47 Authors, 2012; Zeidler et al., 2013; Wu and Tsai, 2007). The intervention engaged students in
48 decision-making about the issue across three lessons. The first lesson took about 45 minutes, and
49 the second and third lessons were each between an hour and 90 minutes. In the first lesson, the
50 teacher provided students with essential background information and data (scientific and
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3 non-scientific) about the issue, and various stakeholders' views extracted from relevant papers
4 and media reports, to make sure students had at least a basic socioscientific understanding. To
5 ensure consistency of teachers' input in different classes, the teachers involved were provided
6 with a set of instructions for them to brief their students of all age-groups about the issue and
7 guided them to discuss the issue without influencing their decisions. The teacher briefing
8 included the presentation of a short video on the present state of shark fishing and its purposes,
9 and the three questions listed below, which provided scaffolds to guide them towards
10 decision-making about the issue:
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- 12 1. What arguments about the issue do you think are important?
- 13 2. What evidence is there to support these arguments? How do you feel about the evidence?
- 14 3. What should be done about the shark fishing issue?

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17 Students answered the questions individually and without conferring. They recorded their initial
18 individual answers on a pre-activity record sheet and these were collected for analysis.
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24 In the second lesson, students were asked to discuss the issue in groups. Each group was asked to
25 discuss the pros and cons of decision alternatives, and then shared their decisions and
26 justifications with the rest of the class by oral presentations, which were video-recorded. In the
27 third lesson, the students in each locality watched the video-recorded group presentations from
28 their international counterparts, after which they returned to their own group to discuss their
29 views again, drawing reference from the views of their international counterparts. Before the
30 lesson ended, each student would form his or her own opinions based on what they gathered
31 from peer interactions within their own class and between different classes. They then recorded
32 their final individual decision on a post-activity record sheet. They were also asked to reflect on
33 factors that might have affected their decisions throughout the three lessons, and record their
34 answers on the post-activity record sheet. With this step-by-step scaffolding, students were
35 increasingly exposed to broader perspectives and a wider range of arguments from peers in their
36 own geographical location and that of their counterparts.
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51 Research question 2: After the group discussion, a focus group interview was conducted for each
52 class to provide in-depth insights into the students' reasoning patterns, and their reflections on
53 the group discussions and exchanges. Hence, there were a total of eight focus groups. These
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3 semi-structured interviews were based on the following questions:
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- 5 ● How did you feel about making a decision at the beginning?
 - 6 ● How did you find the discussion within your group and the exchange with the students in
7 the other locality? How did it affect your decision-making?
 - 8 ● In light of your exchange with students in the other locality, suggest some factors that might
9 have impacted your views and their views on the issue.
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15 Hence, the students' initial decisions prior to the discussion and their post-activity decisions as
16 recorded in the pre- and post-activity record sheets constituted the data for analysis of the
17 possible effects of age, gender and culture. Students' responses collected from the interviews
18 contributed to data about students' perceptions of the activity.
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24 *Methods of analysis*

25 Students' records of their decisions were subjected to qualitative and quantitative analysis,
26 focusing first on the structure of students' decisions and justifications. Emergent dimensions
27 characterizing the structure of their decisions were identified after careful reading of the
28 students' decision records. Decisions of individual students from different age, gender and
29 cultural groups were then subjected to analysis against each of these dimensions, followed by a
30 systematic categorization of these patterns (Lincoln and Guba, 1985), as elaborated in the results
31 section, to obtain a number of response categories under each dimension. Students' responses
32 in each dimension were then differentiated and coded according to these categories. The first
33 author and a research assistant, did the coding independently, with the initial categories modified
34 as circumstances warranted it. With all the categories under each dimension finalized, coding
35 was repeated to ensure good inter-coder reliability according to the finalized sets of themes. The
36 inter-coder reliability was over 80% in the final coding, and the differences were resolved by
37 negotiation by considering each other's basis of their categorization so as to reach a mutual
38 agreement of the best way to code the students' responses..
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51 Descriptive statistics, and inferential statistics by means of t-tests, were applied wherever
52 applicable to illuminate any age, gender or cultural differences, and any interactions among these
53 factors.
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Results

The decisions that individual students made as recorded in their pre- and post-activity record sheets were analysed. All students thought that shark fishing was an issue that needed to be addressed. Three dimensions embedded in the structure of their decisions were identified: the human activities to be controlled; the proposed ways of solving the problem; and the students' underlying concerns that constitute the rationale for their decisions. Although not all three dimensions could be identified in all cases, as students were not asked to express their decisions in that particular way, these three dimensions could be delineated in most of the students' responses, thus providing a useful framework for analysing and comparing students' decisions across the cultural groups. Table 1 lists the categories of responses within each dimension. Table 2 shows examples of how student responses were categorized.

Insert Table 1 and 2 here.

These three dimensions of students' decisions were compared before and after the lessons across age, gender and culture to examine the effect of these demographic variables on students' decision-making. Students' patterns of decision-making within a particular dimension were reflected by the percentages of students in each response category under that dimension. Due to the nature of the data, they could only be analysed using descriptive statistics rather than inferential statistics. However, independent t-tests were used to analyse the average number of response categories coded for a particular student group under each dimension (human activities to be controlled, ways of solving the problem, and underlying concerns) to reflect the range of perspectives students had across different cultural, gender and age groups before or after the activity. The pre- and post-activity changes in these ranges were also compared by paired t-tests to reflect the impact of the activity on students' decisions about shark fishing, and to provide evidence as to whether gender and age played a role in mediating such impacts. The sections below summarise differences in the extent to which the students raised the three dimensions according to cultural group, age and gender. [Due to limitation of limited space, only data for those pairs of groups showing statistically significant differences are shown in the tables provided in these sections. .](#)

Dimension 1: Human activities to be controlled

Cultural differences

The human activities to be controlled are those leading towards sustaining the shark fishing industry. Three major human activities were identified from the students' responses: shark fishing, consumption of sharks (predominantly shark fins), and trading of sharks. Both before and after the classroom intervention an overwhelming majority of students in all cultural, gender and age groups in both localities (between 73% and 92%) targeted the activity of shark fishing, and over 50% of students in all groups suggested restrictions on shark fishing rather than a complete ban. These restrictions included limiting the frequency of shark fishing and the catch size. Fewer students focused on the consumption of sharks (all less than 30%), and even fewer on the trading of shark products (all less than 20%). Before the activity, relatively more UK students (90%) targeted shark fishing than their HK counterparts (70%), whereas considerably more HK (27%) than UK students (10%) tended to target consumption of shark. In terms of changed decisions as a result of the activity, more UK students (pre-activity 8% and post-activity 18%) and fewer HK students (pre-activity 27% and post-activity 16%) targeted shark consumption, indicating that the activity served to close the gap between the two cultural groups in this regard.

Gender differences

In all groups, more female students (17-35%) than males (0-20%) targeted shark consumption before the activity, but this number changed after the activity (Female: 14-21%; male: 15-17%), thus narrowing the gender gap. Quantitative analysis of the range of human activities that students targeted suggested a gender effect within the UK group but not the HK group. UK female students targeted a wider range of human activities (mean=1.21) than their male counterparts (mean=0.94) before the activity, which was statistically significant ($p < 0.05$) (Table 3). However, this gender difference was no longer significant after the activity.

Age differences

Age differences also manifested themselves differently across the two cultural groups. Post-activity, HK juniors were more inclined to target shark fishing (pre-activity 71% and

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3 post-activity 89.8%), while the change was less obvious for their UK counterparts (pre-activity
4 95.6% and post-activity 84.4%). This trend was less noticeable in the senior group. As to the
5 range of human activities to be controlled, junior students as a whole (1.22) showed a
6 significantly greater mean number than their senior counterparts (0.98) ($p < 0.05$). This difference
7 was mainly due to the large difference between the two age groups in HK (Junior=1.31;
8 Senior=0.88) ($p < 0.01$) (Table 3).
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15 Insert Table 3 here.
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18 *Dimension 2: Ways of solving the problem*

19 *Cultural differences*

20 All students suggested ways to reduce the problem, that is, the threat to shark populations.
21 Students' suggested ways of solving the problem fell into four main categories: legislative
22 control, educational solutions, using shark substitutes, and artificial breeding of sharks (Table 4).
23 Both before and after the activity, UK and HK students supported imposing legislative control on
24 shark fishing to a greater extent than any other means. Although more HK than UK students
25 suggested education solutions both before and after the activity, post-activity UK students were
26 more inclined to support educational means (from 7% before to 24% after). More students from
27 both cultural groups mentioned shark breeding to address the problem after the activity (18-21%)
28 than before (7%), and slightly more UK students opted for using shark fin substitutes after the
29 activity.
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40 **Insert Table 4 here.**

41 *Gender and age differences*

42 Gender differences were observed within individual cultural groups. Before the activity, HK
43 females showed a significantly higher mean for an Education solution than males (47% and 22%
44 respectively), but this gap disappeared after the activity (30% and 37% respectively). As shown
45 in Table 5, in both locations, both before and after the activity, senior students on average
46 suggested more ways of solving the problem (1.85) than junior students (0.92), and this
47 difference was significant ($p < 0.001$). Within the senior groups, HK females showed a
48 significantly greater mean (2.25) than UK females (1.36) before the activity ($p < 0.05$); and in the
49 junior groups, HK males had a mean score (1.39) significantly greater than UK males (0.93) after
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3 the activity ($p<0.05$). These data suggest gender interacting with culture and age in impacting on
4 students' choice of ways for shark protection. While more post-activity students identified
5 Education as a way of solving the problem, this change was particularly prominent among UK
6 senior students (pre-activity 12% and post-activity 59%). On the whole, there was a downward
7 trend for legislative means of control.
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16 *Dimension 3: Concerns underlying students' decisions*

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20 *Cultural differences*

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22 Four major concerns were embedded in the students' decisions: protection of sharks for
23 sustainability; animal rights; sharks as a cultural food source; and economic concerns including
24 employment of workers in the trade. At the beginning of the activity, the most often cited
25 concern by students in both cultural groups was to protect sharks somehow, to address the
26 decreasing shark population (41% for HK and 44% for UK). The concern categorized as 'the
27 protection of sharks for sustainability' actually comprises student responses in varying detail
28 ranging from reversing the decreasing shark populations to allowing sharks to reproduce,
29 protecting shark species from extinction, avoiding damage to nature or maintaining a balanced
30 ecosystem. These responses came as a continuum, which does not enable them to be
31 unequivocally differentiated into sub-categories. This was followed by the concern with sharks
32 as cultural food sources (11% for UK and 34% for HK). After the activity, more UK students
33 gave consideration to sharks as a cultural food source (pre-activity 11% and post-activity 19%).
34 Within the HK group, after going through the activity, the general concern with the protection of
35 sharks increased rather markedly (from 41% to 57%).
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48 *Gender and age differences*

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50 Gender differences were not obvious with respect to the type of students' concerns and the range
51 of concerns, except that HK males showed a significantly wider range of concerns (1.08) than
52 UK males (0.58) after the activity ($p<0.01$)(Table 6). Senior students considered a significantly
53 wider range of concerns than their junior counterparts before (senior 1.18; junior 0.74; $p<0.001$)
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3 but not after the activity (Table 6). After the activity, HK juniors exhibited a significantly
4 increased range of concerns from the beginning (0.8) through to the end of the activity (1.15)
5 ($p < 0.01$) (Table 7). This resulted in HK juniors exhibiting a significantly wider range of concerns
6 (1.15) than UK juniors (0.69) ($p < 0.01$) at the end of the activity (Table 6).
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12 Insert Table 6 and 7 here.
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14 15 **Reference to science in the decision-making:**

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17 Most students only made general and superficial references to science-related elements in their
18 decisions, such as maintaining a balanced ecosystem, protecting all or individual species of
19 sharks from becoming endangered or extinct, and increasing the shark populations by artificial
20 breeding, without going into details about how the ecosystem may be hampered by a decline of
21 sharks as a top predator. Even food chains were not commonly mentioned, and, if mentioned,
22 only dealt with superficially. Some senior students, all from the HK group, displayed some
23 lateral thinking in applying a scientific solution to the decline of shark populations:
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29 *“Making use of genetic technology to clone sharks” (Kuen, HK senior male)*

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31 *“Researching the genes of sharks, or perhaps using technology to clone the genes of sharks*
32 *for mass production of sharks.” (Ling, HK senior female)*
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36 **Findings from the student interviews**

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38 All focus group interviews were transcribed. The identification of issues that struck the
39 interviewees allowed exploration of students' thinking about important aspects of the
40 decision-making process and qualitative comparison across the two cultural groups.
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45 **Perceived factors affecting the students' decision-making**

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47 Students were asked at the end of the activity what factors might have impacted their views and
48 the views of other students on the issue. Their responses could be categorized into two types: i)
49 responses related to aspects of the decision-making activity, and ii) responses related to aspects
50 of the issue. More HK students (61%) than UK students (17%) tended to focus on the second
51 category (e.g. ecological, economic or cultural aspects), while the opposite was true for the first
52 category. Under the first category, more UK students than HK students considered the
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3 information provided at the start of the activity more of a helpful influence (34% and 7%
4 respectively), they found the cross-cultural sharing to be influential (24% and 9% respectively),
5 and they mentioned how the activity had encouraged them to think more deeply and broadly
6 (28% and 15% respectively). However, more HK students (21%) than UK students (11%) found
7 peer influences to be important.
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13 **Perceived challenges to students' decision-making**

14 While reflecting on the issues and classroom activities, students raised two main challenges they
15 encountered in their decision-making:
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18 *i) The challenge of evaluating different stakeholders' interests.* All focus groups in both
19 localities raised the difficulty they experienced in evaluating the diverse views of stakeholders,
20 as illustrated by the following interview extracts:
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24 *"I think also it showed how difficult it is to actually make a decision, to actually make*
25 *everybody happy, and also probably it makes us understand why something hasn't been done*
26 *about it already, because I think probably nobody knows the answer to it."* (Victoria, UK
27 senior female)
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32 *"It is hard to make a choice. We know conservation of sharks is a good thing, but it will also*
33 *cause other people to oppose it, because the Chinese people focus on traditional culture. They*
34 *think eating shark fins is a symbol of reputation."* (Man, HK senior male)
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39 *ii) The challenge of collective decision-making*

40 Students discussed the challenges they faced in group decision-making, the biggest of which
41 appeared to be the difficulty in reaching a consensus acceptable to all members of the group.
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44 *"I found it also quite difficult though, because we actually had in our group differing*
45 *opinions on things. So we kind of had to make an ultimatum on the decision."* (Clare, UK
46 senior female)
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51 *"There are difficulties in the process. The group-mates have different views, and I felt difficult*
52 *to analyse which is the best solution."* (Chang, HK junior male)
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3 However, interactions within and among groups helped some students to arrive at more informed
4 decisions, as illustrated by the following interview extracts:
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6 *“Well I think in our group we all kind of thought the same thing. So we didn’t really think*
7 *much about what other people have said, but as the lesson went on, we kind of all started*
8 *having our own opinions on things. So then we kind of then thought ‘Oh yeah, they think that,*
9 *so that might be a good option.”(Nick, UK junior male)*
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15 *“After these three lessons, I think my current solution is better than that in the first lesson. It*
16 *is more effective. I have more confidence after listening to the views of others and do the*
17 *reflection, then my solution will be more comprehensive.”(Fan, HK senior male)*
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22 **Perceived impact of the cross-cultural exchange on students’ decision-making**

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24 The students raised three main areas of impact that the cultural exchange had on their
25 decision-making process: broadening their perspectives on the issue; providing a context for
26 critical thinking about different arguments; the enhanced awareness of culture as a factor
27 impinging on decision-making.
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30 **i) Broadening of students’ perspectives on the issue**

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32 Some students mentioned that the activity increased their awareness and knowledge of the issue
33 and better understood its multifaceted nature, as exemplified by the following interview extracts:
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36 *“I never knew about like Hong Kong eating shark fins, or like the other countries trading them.*
37 *So it was a new topic for me.”(Eleanor, UK junior female)*
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41 *“We should protect the shark. Although it can be used to make a lot of products, we should*
42 *find other substitutes to avoid the extinction of sharks.”(Tong, HK senior male)*
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46 Many students referred specifically to the impact of the exchange of views with their cultural
47 counterparts:
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49 *.“I also felt their ideas were more creative because they thought about shark fin prosthetics*
50 *and vegetarian options as an alternative. Whereas we just spoke on the morals of it, and the*
51 *ethics.” (Alisha, UK senior female)*
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3 “Yes, British students offer a lot of innovative ideas, such as patrolling the waters. HK
4 students did not consider the problem of implementation, and their views can inspire us to
5 think some innovative ways to limit shark fishing.” (Suk, HK senior female)
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10 ii) Providing a context for critical thinking

11 The process of listening to the views of another culture provided a context for students to view
12 their cultural counterparts’ perspectives through a critical lens, and to judge whether those
13 perspectives are justifiable. Students not only reflected on the adequacy of evidence as backing
14 for one’s argument and whether or not a particular idea would work, but also highlighted the
15 differential perceptions and arguments of the two cultural groups and how these differences
16 could be reconciled for improving their proposed actions.
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22 “I think their points are like very valid, like it would be an easier way, like say in some places
23 you are not allowed to fish in for so many years. But at the same time, they might not work
24 as – where you could like – one fish would be populated, they may not repopulate quick
25 enough.” (Les, UK junior male)
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31 “I believe that their points weren’t broad. Like they’re all close together, like, we were
32 thinking outside the box at the same time....Like we talked about educating in schools, and like
33 targeting it from the inside, and not just it becoming illegal or laws or anything like that or
34 new hooks. Those are all mainly to do with like government tool things. But we believe that
35 you can’t solely leave it up to the Government, where the Government probably is part of the
36 problem at the same time.” (Steve, UK senior male)
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43 “Compared with UK students, we both had our own good arguments. I would like to adopt its
44 advantages to improve my plans. This activity can develop my critical thinking, and reflect on
45 the effectiveness of those policies from the perspective of different stakeholders to see whether
46 it can be implemented.” (Ching, HK senior female)
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51 “They [UK students] overlooked the situation of the fishermen.” (Ying, HK junior female).
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55 iii) Enhanced awareness of culture as a factor impinging on decision-making
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3 After the activity, students seemed more aware of and sensitive to the importance of culture in
4 influencing decision-making about such conservation issues as shark fishing. This enhanced
5 cultural awareness appeared to be more deeply felt by UK students.
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8 *“I think we were much less confident than they were. So I thought that they had – they might*
9 *have had it (shark fins) before, so they might have seen how they taste, how they thought about*
10 *them personally. Whereas I don’t think any of us here have actually had...” (Paul, UK junior*
11 *male)*
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17 *“I am comfortable with my decision but I know there could be errors with it because I’m not*
18 *cultural to the shark finning; shark fin soup and things like that, ‘cos I’ve never experienced it*
19 *myself.”(Alexander, UK senior male)*
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24 By contrast, a rather common view among HK students seemed to be that the decisions of their
25 UK counterparts might be limited by their lack of understanding of the Chinese culture.
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27 *“...because they do not eat sharks fins, so they do not understand this matter.”(Yee, HK junior*
28 *female)*
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32 *“They do not have this traditional culture, so it is easier for them to come up with*
33 *solutions.”(Hau, HK senior male)*
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37 **Discussion**

38 ***Effects of culture, age and gender***

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40 The three dimensions characterising the students’ decisions, which have been identified in this
41 study - the stakeholders targeted, the ways of solving the problem, and the students’ underlying
42 concerns - could provide a useful framework for analysing decision-making by students about
43 shark fishing, or a similar type of conservation issue with regard to cultural, gender and age
44 differences. Both HK and UK students targeted shark fishermen to a far greater degree than
45 consumers or traders. Legislative control appeared to be the most common means of solving the
46 problem, although students tended to shift to educational solutions after the activity. Ecological
47 concerns were the most common rationale underlying students’ decisions within both cultural
48 groups, followed by cultural and economic concerns.
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5 Overall, both cultural groups shared similar patterns in their decisions about shark fishing. This
6 shows that students do not necessarily identify with their own culture (in this case shark fin
7 consumption in HK) in making decisions about conservation issues. The need to conserve
8 wildlife seems to have gained a foothold within the younger generation across both cultures. The
9 environmental stigma attached to shark fin consumption might explain why HK students, despite
10 their cultural links with shark fishing, did not appear to show stronger identification with or
11 support for this practice than UK students. Despite these commonalities, there are variations
12 between the two cultural groups. Before the activity, more UK students were inclined to control
13 fishing than their HK counterparts, whereas more HK than UK students tended to target
14 consumption of shark fins; and HK students favoured educational means to a far greater extent
15 than UK students. More HK students cited the consumption of sharks as a cultural food source in
16 their decision-making compared with their UK counterparts. However, this does not mean the
17 HK students agreed with shark consumption, but rather they were taking cultural contexts into
18 consideration in deciding how to address the issues. Furthermore, HK students showed a wider
19 range of concerns than UK students both before and after the activity. This might be explained
20 by HK students' heightened awareness of shark fishing due to the perceived relevance of the
21 issue to their own culture, and the controversy about shark fishing, fuelled by the advocacy of
22 environmental protectionists to eliminate shark fins from Chinese banquets (Shark Savers, 2011).
23 Age seems to have an effect, particularly in respect of the ways of solving the problem, with
24 many more senior students considering Education than junior students. Senior students also
25 exhibited significantly more ideas to solve the problem both before and after the activity.
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43 From the interview findings, UK students seemed to have little knowledge about the issue of
44 shark fishing. This echoes Friedrich et al.'s (2014) findings that many UK students were not
45 aware that sharks were commercially fished in European seas, and that shark meat was
46 consumed in the UK. Many of them thought shark consumption is associated only with the UK's
47 Asian community. The authors advocated better public understanding of shark conservation
48 issues by engaging citizens through labelling of products derived directly or indirectly from
49 sharks.
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3 Although many of the participants expressed concerns about the potential ecological impacts of
4 shark fishing, there was a relative lack of in-depth or explicit references to science among both
5 HK and UK students, in the concerns they expressed and the additional information they
6 suggested should be provided. This sparse reference to science, means it is not certain whether
7 senior students utilized scientific knowledge more than junior students in their decision-making
8 about shark fishing, but a substantial proportion of students were seemingly content with the
9 knowledge provided. These findings seem to echo O'Bryhim and Parsons' (2015) assertion that
10 age and education level make little difference to people's knowledge about the role of sharks as
11 top consumers in the marine ecosystem, as well as reports that that students' ability is limited in
12 applying science in SSI discussions (Jimenez-Aleixandre et al., 2000; Kolsto, 2001, Ratcliffe,
13 1997). The possible reasons for such limitation of students' ability will be discussed in the
14 conclusion and implications section.
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Impact of the activity on students' decision-making about shark fishing

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26 The existence of changes between respondents' pre and post-activity decisions, indicates that the
27 activity had exerted an impact on the students' decisions. After the activity, there was also a
28 statistically significant increase among UK students in their range of ways of solving the
29 problem, possibly due to an increased understanding of the issue of shark fishing, as revealed by
30 the interviews. Moreover, the findings imply possible mediating effects of both age and gender
31 on the impact of the activity on students' decision-making in both cultural groups. For instance,
32 after the activity, a much greater proportion of UK senior students identified Education as a way
33 of solving the problem. HK junior students showed a wider range of concerns and means of
34 solving the problem, and the increased inclination to target shark fishing by the HK group was
35 more conspicuously shown by the junior group than by the senior group, and by females
36 compared to males. Whether such changes were due to the within-culture group discussion or
37 cross-culture exchange is not certain, but the interview data showed that the latter had exerted at
38 least some influence, especially among the UK students, who reported cross-cultural sharing as
39 an important factor affecting their decisions.
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53 Compared with the HK students, UK students, despite not perceiving the issue as relevant to
54 their culture, seemed to be more sympathetic toward cultural and economic concerns after the
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3 activity than they did before. This seemed to contradict the findings on UK and HK 16-17 year
4 old students' attitudes towards whaling as reported by Authors (2015). In the case of whaling,
5 which also has no direct link with the UK, Authors (2015) found that UK students were less
6 accepting than HK students toward commercial and research whaling. This implies that students'
7 decisions about conservation of animals are dependent upon the type of animals in question, and
8 their attitudes toward particular species. As concluded by Evagorou et al (2012) from their
9 findings that students' identification with the 'actors' of the issue is important in their
10 decision-making, the following utterances by two junior UK students may provide insights into
11 their perceived difference between sharks and whales:
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20 *"Cos sharks are predators and they would eat people but at the same time, they're still a*
21 *species."* (Chris, UK junior male)
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25 *"...but it's stereotypical for sharks to eat us, not like...shark er we eat sharks, so yeah"* (Donna,
26 UK junior female)
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31 **Conclusion and implications**

32 In the present study, students from the two locations did not differ in their patterns of decisions
33 in broad terms, even though HK students are culturally linked to shark fin consumption. This
34 reflects a growing view that the younger generation in HK has become aware of the issue of
35 shark conservation as brought about by their culinary culture. There were some noticeable
36 patterns of changes to students' decision-making after going through the activity. These include
37 reciprocal changes in certain sub-categories under each decision dimension, implying mutual
38 influences of the two cultural groups possibly as a result of enhanced cross-cultural
39 understanding, and the mediating effects of gender and age on the impact of the activity on the
40 two cultural groups. The findings appear to suggest that the impact of the activity was more
41 conspicuous among HK junior students and UK senior students than other sub-groups. HK
42 students showed a significant increase in both their ways of solving the problem and their
43 underlying concerns after the activity, while UK senior students showed a marked increase in
44 their ways of solving the problem after the activity.
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3 Despite this, the study suggests a number of challenges students would experience in making
4 decisions about shark fishing or similar conservation issues, which have implications for SSI
5 education. These challenges occur at three levels. The first challenge is at the individual level,
6 where students experienced varying difficulties in balancing different stakeholders' views. The
7 second challenge is at the group level associated with the complexity of group decision-making
8 and the difficulty in arriving at a consensus through negotiating the different views and
9 perspectives of group members. The ambivalence exhibited by students in making decisions at
10 both individual and group levels may stem from a lack of the ability to adopt value-based criteria
11 as a guide to differentiate the relative importance of different perspectives, or simply their
12 inability to develop their own values in relation to animals and their conservation. Thus, explicit
13 discussions on values would likely help students to weigh alternative solutions and make
14 sensible choices. It will also help to ground decision-making skills at a deeper level to facilitate
15 their transfer to other issues.
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27 The third challenge arises at the cultural level. In this study, students from both locations were
28 exposed to the views of students from another culture with different degrees of association with
29 the issue. Subsequent to the group discussion and cultural exchange, students' decisions had
30 changed to varying degrees, possibly taking into account their peers' views. More UK students
31 showed considerations of cultural concerns about an issue hitherto unknown to them. The
32 challenge to students at this level is how far culture needs to be considered as a mitigating factor
33 in decision-making about conservation issues with a global impact. Again, the decision needs to
34 be criteria or value-based to assist students in weighing alternatives.
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43 Achieving a better understanding of the views of different cultures with different connections to
44 any conservation issue in question, and the rationale for such views, can be argued as the first
45 step to resolving global issues- which entails international efforts. Opportunities could be
46 provided for different cultures to be exposed to the issue and its cultural roots, and to come
47 together to resolve their differences. The present study shows a way of how this could be done,
48 with evidence of impact on students of different ages, genders and cultures in terms of their
49 understanding of the issue and perspectives for consideration. It is important to take such factors
50 into consideration in developing pedagogical approaches to SSI education at different stages of
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3 schooling. This kind of SSI-oriented activity emphasizing open discussion and cross-cultural
4 exchange has a natural appeal to students because of its novelty. As a UK junior student put it,
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8 *“And it was like different to what we do in like normal school, and yeah, it was cool.”*
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11 However, for this kind of pedagogical approach to produce sustainable and transferrable impact,
12 more thought needs to be given to develop students’ ability to make informed decisions. The
13 present study points to the desirability to promote their understanding of the nature of
14 conservation issues and scientific knowledge of the role of animals in the ecosystem, their ability
15 to reason critically through different perspectives, their underlying values with a view to
16 developing informed criteria for making decisions, and their sensitivity to the cultural roots of
17 the issues and the complexity that needs to be dealt with in resolving the issue. Research has
18 already indicated, “people with more knowledge pertaining specifically about sharks had
19 potential behaviours more supportive of their conservation” (O’Byrhim and Parsons, 2015, p. 1).
20 A previous study by Tsoi et al (2016) has already pointed to the lack of sufficient knowledge
21 among 11 to 12-year-old HK primary students, and their misconceptions about the significance
22 of sharks in the marine ecosystem. This study further suggests that secondary students did not
23 seem to have gained much progress in developing knowledge in this aspect. Hence, there is a
24 case for science lessons to address biological conservation in a more systematic and in-depth
25 way. The students’ general and superficial understanding of scientific knowledge about
26 conservation, derived probably from the media coverage of conservation issues, can be used as a
27 starting point for constructing more complex ecological concepts. Issues that could lead students
28 to informed decision-making could be used as a context, with more background scientific
29 information provided, to deepen students’ understanding of ecological knowledge through data
30 analysis and construction of evidence-based arguments. As informed by the findings of this
31 study, with respect to the difference in the factors HK and UK students perceived to be
32 influential to their decision-making, there may be a need for a slight differentiation in the
33 approaches used for students from different cultures. For students who are culturally related to an
34 issue, it may be more helpful to deepen their understanding of the various relevant perspectives,
35 and the relative importance of these perspectives based on value and practical considerations,
36 and to encourage critical reflection on one’s cultural perspectives in relation to those of others.
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3 For those who are not culturally related to the issue, a comprehensive overview coupled with
4 cross-cultural sharing may be an effective starting point to induct them into the issue before any
5 meaningful discussion could result.
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10 This study has revealed possible differences related to gender and age. However, due to the small
11 sample size, larger-scale studies will need to be undertaken to explore more deeply the influence
12 of these demographic factors on students' decision making and their possible interactions with
13 culture, for instance, whether students of different gender or age are more prone to emphasize
14 certain perspectives of the issue, or decision alternatives. In this study, the influences of
15 intracultural and cross-cultural interactions could not be clearly delineated. Future studies may
16 attempt to adopt more explicit cross-cultural interactions beyond video-recorded exchange to
17 include dialogue between cultural groups in different locations in the form of video-conferencing,
18 or face-to-face discussions between cultural groups within the same location. These results
19 obtained from more in-depth age, gender and cultural studies could help to tailor pedagogical
20 approaches in more nuanced ways for more effective engagement of different student groups
21 with SSI decision-making.
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Human activity to be controlled	Ways of solving the problem	Underlying concern
Shark fishing Consumption of sharks Trading of sharks	<ul style="list-style-type: none"> • Legislation (fishing, consumption, restauranting/trading) • Education (general public, traders, fishermen, consumers, traders/restaurateurs) • Others (e.g. improving fishing technology to minimize by-catch, substituting shark fins/meat/medicine with other substitutes, breeding of sharks/Shark farming) 	<ul style="list-style-type: none"> • Protection of sharks for sustainability (increasing the shark populations, making shark populations sustainable, protecting endangered species from extinction, maintaining balance of nature or balance of ecosystem, avoiding damage to food chains, etc.) • Animal rights • Cultural concern/cultural food source • Economic/employment issues • Others (e.g., political concerns)

Commented [GM1]: Activity

Table 1: Categorization of students' decisions within the three dimensions

Example of student's decision	Dimension		
	Human activity to be controlled (B)	Ways of solving the problem (W)	Underlying concerns (C)
"Educating the public to build correct values through mass media and school talks (<i>W: Education</i>); restaurants to use vegetarian fins (<i>B: eControlling consumption of shark fins</i> ; <i>C: Cultural concerns</i>); legislate to limit shark catch (<i>B: eControlling fishing</i> ; <i>C: Protecting</i>	<ul style="list-style-type: none"> • Consumption of sharks • Shark fishing 	<ul style="list-style-type: none"> • Education • Scientific research and technology 	<ul style="list-style-type: none"> • Protection of sharks for sustainability • Cultural concerns

Commented [GM2]: Activity

<p><i>sharks</i>); use cloning to rear more sharks (<i>W: Scientific research and technology</i>)” (A HK senior student)</p>			
<p>“The treaty for protecting sharks should be made more stringent (<i>B: <u>C</u>ontrolling fishing; W: <u>L</u>egislation; C: <u>P</u>rotecting sharks</i>); use other medicines as substitutes for shark-derived medicinal products (<i>C: <u>C</u>ultural concerns</i>); send patrol to control shark fishing (<i>B: <u>e</u>Controlling fishing; W: <u>L</u>egislation; C: <u>P</u>rotecting sharks</i>); educate Chinese people the importance of protecting sharks (<i>W: <u>E</u>ducation; C: <u>P</u>rotecting sharks</i>)” (A HK junior student)</p>	<ul style="list-style-type: none"> • Shark fishing • Consump-tion of sharks 	<ul style="list-style-type: none"> • Legislation to control fishing • Education to conserve sharks/reduce consumption 	<ul style="list-style-type: none"> • Protection of sharks for sustainability • Cultural concerns
<p>“We should stop shark fin fishing (<i>B: <u>C</u>ontrolling fishing</i>) because it is animals’ abuse (<i>C: <u>A</u>nimal rights</i>) and because they are becoming endangered (<i>C: <u>P</u>rotection of sharks</i>) by weddings and banquets (<i>C: <u>e</u>Cultural concerns</i>)” (A UK junior student)</p>	<ul style="list-style-type: none"> • Shark fishing 	<p>-</p>	<ul style="list-style-type: none"> • Protection of sharks • Animal rights • Cultural concerns

Table 2: Examples of coding of student responses to different categories under the three dimensions

(The words that are underlined and in *italics* are inserted to show how student responses were coded under the three dimensions.)

	Group	Mean	SD	t value	Cohen's d
Number of human activities controlled per student (Before activity)	UK Female	1.21	0.41	2.50*	0.64
	UK Male	0.94	0.43		
Number of human activities controlled per student (After activity)	Junior	1.22	0.57	2.39*	0.38
	Senior	0.98	0.68		
	HK Junior	1.31	0.65	3.29**	0.67
	HK Senior	0.88	0.63		

*p <.05; **p<.01

Table 3: Differences between different age, gender and locality groups in the number of human activities to be controlled before and after the activity

[Note:

Due to limited space, only data for those pairs of groups showing statistically significant differences are shown.]

Ways of solving the problem	Groups	Before (%)	After (%)	Changes (%)
Legislative	HK	68.6	71.6	↑ 3
	UK	67.7	58.1	↓ 9.6
Education	HK	32.4	34.3	↑ 1.9
	UK	6.5	22.6	↑ 16.1
Substitutes	HK	7.8	8.8	↑ 1
	UK	6.5	14.5	↑ 8
Breeding	HK	7.8	20.6	↑ 12.8
	UK	8.1	17.7	↑ 9.6

Table 4: Changes in HK and UK students' choice of ways of solving the problem

Commented [GM3]: activities

Commented [GM4]: activities

Commented [GM5]: activities

	Group	Mean	SD	t value	Cohen's d
Number of ways of solving the problem per student (Before activity)	Junior	0.92	0.83	-5.09***	0.87
	Senior	1.85	1.25		
	HK Senior Female UK Senior Female	2.25 1.36	1.55 0.67	2.2*	0.74
Number of ways of solving the problem per student (After activity)	HK Junior Male	1.39	0.99	2.36*	0.57
	UK Junior Male	0.93	0.55		

*p <.05; ***p<.001.

Table 5: Differences between different age, gender and locality groups in the range of ways of solving the problem before and after the activity

[Note:

Due to limited space, only data for those pairs of groups showing statistically significant differences are shown.]

	Group	Mean	SD	t value	Cohen's d
Number of concerns per student (Before activity)	Junior	0.74	0.59	-3.77***	0.63
	Senior	1.18	1.79		
Number of concerns per student (After activity)	HK Junior	1.15	0.81	3.02**	0.6
	UK Junior	0.69	0.73		
	HK Male	1.08	0.73	3.12**	0.66
	UK Male	0.58	0.79		

*p <.05; ***p<.001.

Table 6: Differences between different age, gender and locality groups in the number of concerns behind their decisions before and after the activity

[Note:

Due to limited space, Only data for those pairs of groups showing statistically significant differences are shown.

Groups	Number of Concerns per student				t Value	Cohen's d
	Before		After			
	Mean	SD	Mean	SD		
HK Junior	0.8	0.61	1.15	0.81	-2.96**	0.49

*p <.05; **p<.01; ***p<.001.

Table 7: Changes in the number of concerns of HK junior students after the activity