Examining the Effectiveness of Urban Planning Exhibitions in Planning Communication: A Contextual Model of Learning

Abstract : Urban planning exhibitions have been a long-standing element in planning culture, on a worldwide level. Until now, there has been a considerable gap in researching the efficiency of urban planning exhibitions in communication, especially from a quantitative perspective. Rooted in communicative planning and built on Generic Learning Outcomes and Contextual Model of Learning theory, this paper aims to explore the role of urban planning exhibitions in communication and the factors that influence their efficiency, using the recently opened Guangzhou Urban Planning Exhibition Hall (UPEH) as an example. The 115 participants in this study were divided into two groups (experimental and control) and asked to answer a series of urban planning questions before and after visiting the Guangzhou UPEH. Results showed that except for the level of education, the *personal* and *sociocultural* factors had no significant effect on changes in participants' knowledge on the subject. However, the *physical* factors of participants' visits, including the length of the visit, the number of exhibits seen by participants and the degree of engagement with the top-rated exhibits, significantly influenced learning about urban planning. The results demonstrated that urban planning exhibitions can provide inclusive platforms in facilitating planning communication and public engagement.

Keywords: planning communication, urban planning exhibitions, contextual model of learning, repeated measures design

1 Introduction

Urban planning is a complex and multifaceted endeavour that aims at adapting the form and function of cities to the diverse needs of stakeholders, and a means of bringing about political, social and physical change (Hein, 2015). The current pace of urbanisation has brought a growing awareness for pressing urban challenges. Finding ways for more sustainably adapting cities towards the impacts of climate change, and coping with critical resource scarcity is critical for cities globally (Odendaal, 2012). This has become an important challenge for planning and design professionals, engineers and the general public. Therefore, communicating contents of planning to stakeholders is important for a shared understanding towards a sustainable development of city regions (Chen et al., 2020; Shilon & Eizenberg, 2020).

To improve planning communication public hearings, discussion groups, and other forms of participation have been tried with varying degrees of success as part of a broader democratization process in urban planning that began in the 1970s, particularly in European countries and the US (Li et al., 2020). In recent decades, the use of various information and communication technologies (ICTs) in planning is expanding, facilitating new ways for citizens and local residents to voice their opinions. Implementation of ICTs in planning communication often focuses on a limited set of media and with few real-world implementations to include wider audiences (Billger et al., 2016; Eilola et al., 2023).

Urban planning exhibitions, on the other hand, have long been used as a real-world communication tool to raise public awareness of urban planning. More than a century ago, Patrick Geddes (1915) proposed the 'Outlook Tower' in Edinburgh as a forerunner of a planning exhibition. Later, the 'Futurama' ride was installed at the New York World's Fair in 1939. Other examples include 'The Hannover 2000 Expo', which served as the centrepiece for a confluence of world fairs, model planning and housing exhibitions; 'Barcelona in Progress', a permanent exhibition featuring a 1:1000 scale model of the city in 2004; and the idea of the 'Urban Room', which was proposed by Farrell and put into practice in more than 15 British cities and towns, typically as pop-up settings that were limited in size and scope (Tewdwr-Jones et al., 2020; Lu, 2021).

Urban Planning exhibitions differ in size and characteristics depending on budget and planning context (Freestone & Amati, 2016; Hein, 2015). In particular in China with its enormous growth and spreading of urban areas there has been a rapid increase in the number of Urban Planning Exhibition Halls (UPEHs) recently (Fan, 2014; Wu, 2000), totalling 880 UPEHs according to nationwide market survey (Chen & Chen, 2017). UPEHs are often situated in large dedicated buildings in which a multitude of themes focusing on past, present and future urban planning of a particular area is exhibited through a broad range of visualisation tools (Fan, 2014; Lu et al., 2020).

Urban planning exhibitions share many similarities in terms of exhibition design, including purpose of exhibition, visualisation media, and planning content. They serve as tools for city branding, planning communication and public engagement (Carrière & Demazière, 2002; Fan, 2014). They make use of maps, plans, photographs, perspectives, models, AR, VR and other advanced digital tools for planning communication and public engagement (Fan, 2014; von Petz, 2010). In urban planning exhibitions the past, present, and future of a specific area or proposed development is presented (Carrière & Demazière, 2002; Hein, 2015; Lu et al., 2020). Chinese UPEHs are distinguished from Western examples in terms of facilitation and resourcing. UPEHs in China are permanent and often very large urban exhibition spaces, that are owned and resourced by the government. In contrast, most examples in other countries are funded by a combination of private sector groups, public-private-partnerships, NGOs, and universities, and can be either permanent, periodic or pop-up (e.g. Tewdwr-Jones et al., 2020).

There are only a few studies that have been conducted around urban planning exhibitions worldwide, concerning their historical development (Freestone, 2015; Freestone & Amati, 2011; Hein, 2015; Nakajima, 2021; Tewdwr-Jones et al., 2020), exhibition design (Tan & Cho, 2022; Lu et al., 2020; Qian & Wu, 2012), and its connected political metaphors (de Jong et al., 2018).

So far, there is a gap in research on the effects of urban planning exhibitions on the communication of planning contents. Hein (2015) looked into the history of urban planning competitions and exhibitions and argued that they provide a way to highlight breakthroughs and systemic challenges in urban planning. Some studies have explored their role in user satisfaction (Bern & Røe, 2022; Fan, 2014; Tewdwr-Jones et al., 2020, Tan and Cho 2022). For example, through post-visit ratings and interviews Fan (2014) found that visitors were generally content with its role of communication while there are limited opportunities for public participation. Tewdwr-Jones et al. (2020) demonstrated that the visitor interaction board, which was used at the Newcastle City Futures exhibition, received predominantly positive feedback from visitors. Nakajima (2021) compared the post-visit ratings of experts and non-experts for each program presented at the 'Urbanism Places Exhibition 2018' in Shinjuku, Japan.

These studies primarily focused on examining the effectiveness of urban planning exhibitions in communication through post-visit rating. This approach provides limited objective evidence and in-depth understanding of what visitors have learned. A comprehensive evaluation method is therefore needed to enhance understanding of the communication efficiency of urban planning exhibitions (Hall et al., 2017). Urban planning exhibitions can be considered as free-choice learning settings, similar to museums, science centres, and other informal educational institutions. Related to visitor experience in informal learning settings, providing scientific and comprehensive

105 evidence for examining the effectiveness of urban planning communication, there exist
106 several models and theories (Kirchberg & Tröndle, 2012).
107
108 Rooted in communicative planning (Healey, 1996), and built upon Generic Learning
109 Outcomes and Contextual Model of Learning theory (Falk & Storksdieck, 2005;
110 Hooper-Greenhill, 2007), this study aims to examine the efficiency of urban planning
111 exhibitions in planning communication and the factors that may affect public learning.
112 Since UPEHs can be representative and exemplary of urban planning exhibitions
113 worldwide, particularly in relation to exhibition contents, they are ideal research
114 subjects for studying how the public perceive and experience urban planning
115 exhibitions. This research aims to answer two questions: (1) Comparing before and
116 after a visit to the urban planning exhibition hall, is the participants' knowledge about
117 urban planning improving? And, if so, (2) What factors affect knowledge acquisition
118 at the urban planning exhibition?
119

120 # 2 Theoretical framework

121 ## 2.1 Communicative planning theory

122 Communicative planning, originating in the 1990s, is based on Habermasian
123 communicative rationality (Habermas, 1979) and a social constructivist paradigm. It
124 emphasizes the importance of human interactions and social processes in shaping the

125 world through planning (Healey, 2003). This approach encourages planners to adopt
126 more collaborative roles, rather than acting as disciplinary experts (Healey, 1996).
127 Throughout the communicative planning process, information should be produced
128 collectively by the full range of stakeholders who may be affected by the outcome of
129 the process. Visualisation media plays a vital role in communication (Potts, 2020). Yet,
130 in the early 1990s when the 'communicative turn' was proposed, visualisation media
131 were in their infancy.
132
133 Since then, a massive evolution of new technologies and tools has taken place. Planning
134 platforms on the Internet have enabled stakeholders to engage with planning issues in
135 new, consultative ways, while computer systems have revolutionized urban design
136 through virtual simulations and city models. Also, mobile technologies and social
137 media offer opportunities for increased stakeholder interaction with planners (Billger
138 et al., 2016; Eilola et al., 2023; Schroth et al., 2015).
139 .
140 Extending on communicative planning theory, this study aims to investigate the
141 effectiveness of how we communicate using contemporary visualisation media in a
142 real-world planning exhibition setting for a large audience. In prior studies, user
143 feedback collection (i.e., post-use questionnaire and interview) was a common form of
144 user experience and usability evaluation. Its reliance on user perceptions limits its
145 ability to provide objective evidence; robust and well-documented usability evaluations

146 are still lacking in the planning literature (Benyon, 2019; Eilola et al., 2023; Hall et al.,
147 2017).
148

149 **2.2 Generic Learning Outcomes and Contextual Model of Learning Theory**

150 To improve the robustness of evaluating the effectiveness of communication in urban
151 planning exhibitions, this study incorporates two classical theories from museum and
152 public exhibition studies: Generic Learning Outcomes (Hooper-Greenhill, 2007) and
153 the Contextual Model of Learning (Falk & Storksdieck, 2005). Generic Learning
154 Outcomes stipulate that one's learning from informal education settings include
155 'enhancing knowledge, acquiring skills, developing interests, improving attitudes and
156 emotions, and changing behaviours' (Hooper-Greenhill, 2007). The Contextual Model
157 of Learning theory argues that informal learning is jointly shaped by one's *personal*,
158 *sociocultural* and *physical* contexts. The *personal* context refers to the personal and
159 genetic history that an individual carries with him/her to the environment; the
160 *sociocultural* context represents the social and cultural relationships that one is bonded
161 with; and the *physical* context includes both the physical setting of the exhibitions and
162 the contents (Falk & Storksdieck, 2005).
163

164 Taking into account the setting of the urban planning exhibitions, we hypothesise that
165 the following contexts can influence the communication efficiency: *personal*
166 (participants' age, gender, education level, occupation, familiarity with the city,

motivation for visiting, and prior knowledge of urban planning), *sociocultural* (whether participants come alone, whether the researcher is present, and whether they use a guide) and *physical* (exhibit exposure and exhibit quality) factors (see Figure 1). These were used as the theoretical framework to answer our research questions.

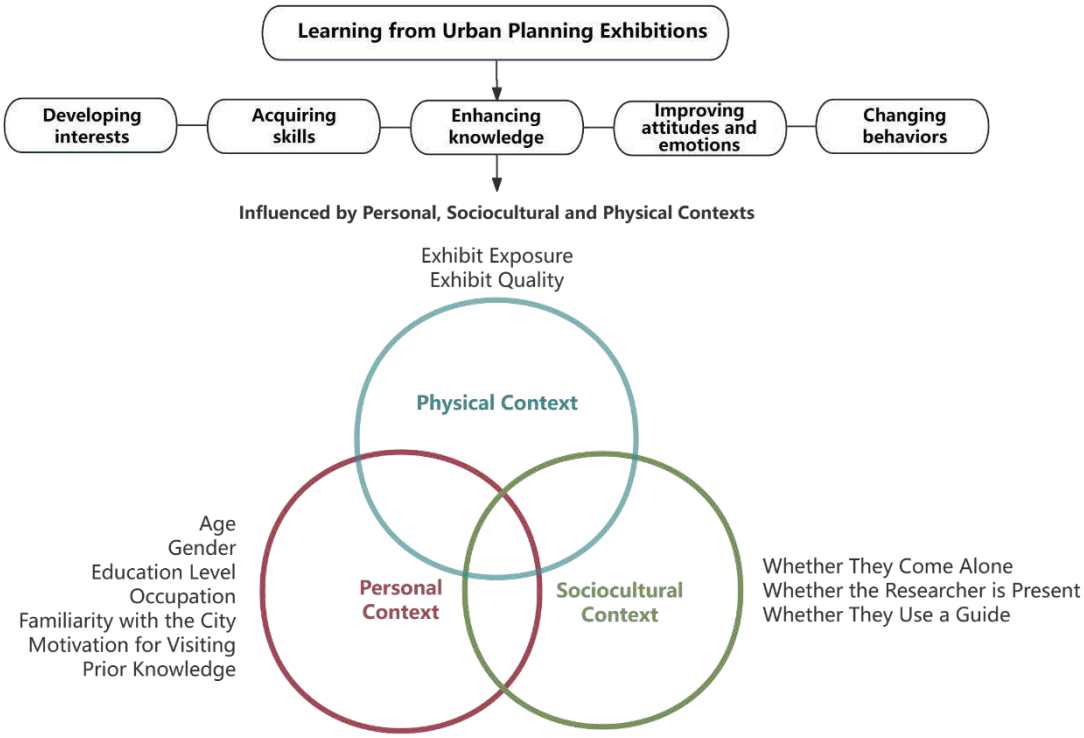

Figure 1 Research framework

3 Materials and Methods

3.1 Research design

The overall goal of this study was to investigate changes in participants' knowledge of urban planning after visiting the UPEHs, as well as the factors that influenced those changes. This study adopted a repeated measures design method based on Hooper-Greenhill (2007), Falk and Storksdieck (2005), and Bitgood et al. (1988). As shown in Table 1, participants were classified into two groups at random: The experimental

(Group A) and the control group (Group B). The experimental group received questionnaires pre- and post-visit and were unobtrusively observed during their visit. The control group filled out questionnaires before and after visiting the exhibition, without the researcher's presence (explained in Section 2.4). This research design offers three advantages: First, to eliminate a potential bias of the researcher's presence; second, to examine the *physical* variables that participants spent with the UPEH; and third, to save time for the researcher.

Table 1 Research Design

Group number	Before visiting	During visiting	After visiting
Group A Experimental group	**Questionnaire** 1. Personal info 2. Self-assessment 3. Structured questions 4. Open-ended questions	**Unobtrusive observation** 1. Overall time 2. Time spent with particular exhibit 3. Interaction with others	**Questionnaire** 1. Re-evaluate self-assessment 2. Revise structured questions 3. Revise open-ended questions
Group B Control group	**Questionnaire** 1. Personal info 2. Self-assessment 3. Structured questions 4. Open-ended questions	NA	**Questionnaire** 1. Re-evaluate self-assessment 2. Revise structured questions 3. Revise open-ended questions

3.2 Research setting

The authors paid visits to all UPEHs in the Pearl River Delta, including Guangzhou, Dongguan, Hongkong, Nansha, Shenzhen, and Macau (Figure 2). The UPEHs were examined using predefined criteria (Table 2), including opening year, floor area, media richness, social impact, and permission to conduct the research. The Guangzhou Urban

Planning Exhibition Hall (UPEH) was chosen for its representativeness of broader UPEHs and its ability to accommodate the research.

Figure 2 Examples of UPEHs in the Pearl River Delta

Left: Foshan UPEH; Top centre: Hongkong City Gallery; Centre: Nansha Pearl Bay Exhibition Hall; Bottom centre: Dongguan UPEH; Top right: Shenzhen Bao'an District Urban Planning Exhibition Hall; Centre right: Shenzhen Museum of Contemporary Art & Planning Exhibition; Bottom right: Guangzhou UPEH.

Source: produced by the authors

Table 2 Predefined examination sheet of UPEHs in the Pearl River Delta

City	Name	Year of opening	Floor space (m^2)	Media richness	Social impact	Permission for research
Dongguan	Dongguan Urban Planning Exhibition Hall	2017	15000	***	**	**
Foshan	Foshan Urban Planning Exhibition Hall	2019	20000	***	***	**
Guangzhou	Guangzhou Urban Planning Exhibition Hall	2018	84000	***	***	***
	Nansha Pearl Bay Exhibition Hall	2016	3800	**	*	*
Hongkong	Hongkong City Gallery	2012	3000	**	**	**
Shenzhen	The Museum of Contemporary Art & Planning Exhibition	2020	88185	***	***	*

City	Name	Year of opening	Floor space (m²)	Media richness	Social impact	Permission for research
Shenzhen	Bao'an District Urban Planning Exhibition Hall	2016	5300	**	*	**
Zhuhai	Zhuhai Hengqin Urban Planning Exhibition Hall	2012	22242	**	*	*

Note: '*'to '***' resembles a better performance in that genre according to onsite visit by the authors and UPEH brochures

Guangzhou UPEH is located in the provincial capital of Guangdong, the political centre of the Pearl River Delta. The UPEH provides convenient road, subway and pedestrian access (Figure 3). It was opened to the public in 2017; it is free of charge and attracts about 300, 000 visitors yearly. The Guangzhou UPEH possesses an exhibition area of 30, 000 m^2 (which is more than four full size football pitches) with 119 sets of planning exhibits on three floors (see Supplementary materials Ⅰ and Ⅱ for floor maps and exhibition catalogues). The exhibition includes 8 themes: (1) Urban development and layout, (2) Future planning, (3) Economy and geography, (4) Landscape and environment, (5) History and culture, (6) Historical preservation of ancient buildings and districts, (7) Transportation, and (8) Utilities (Lu, 2021).

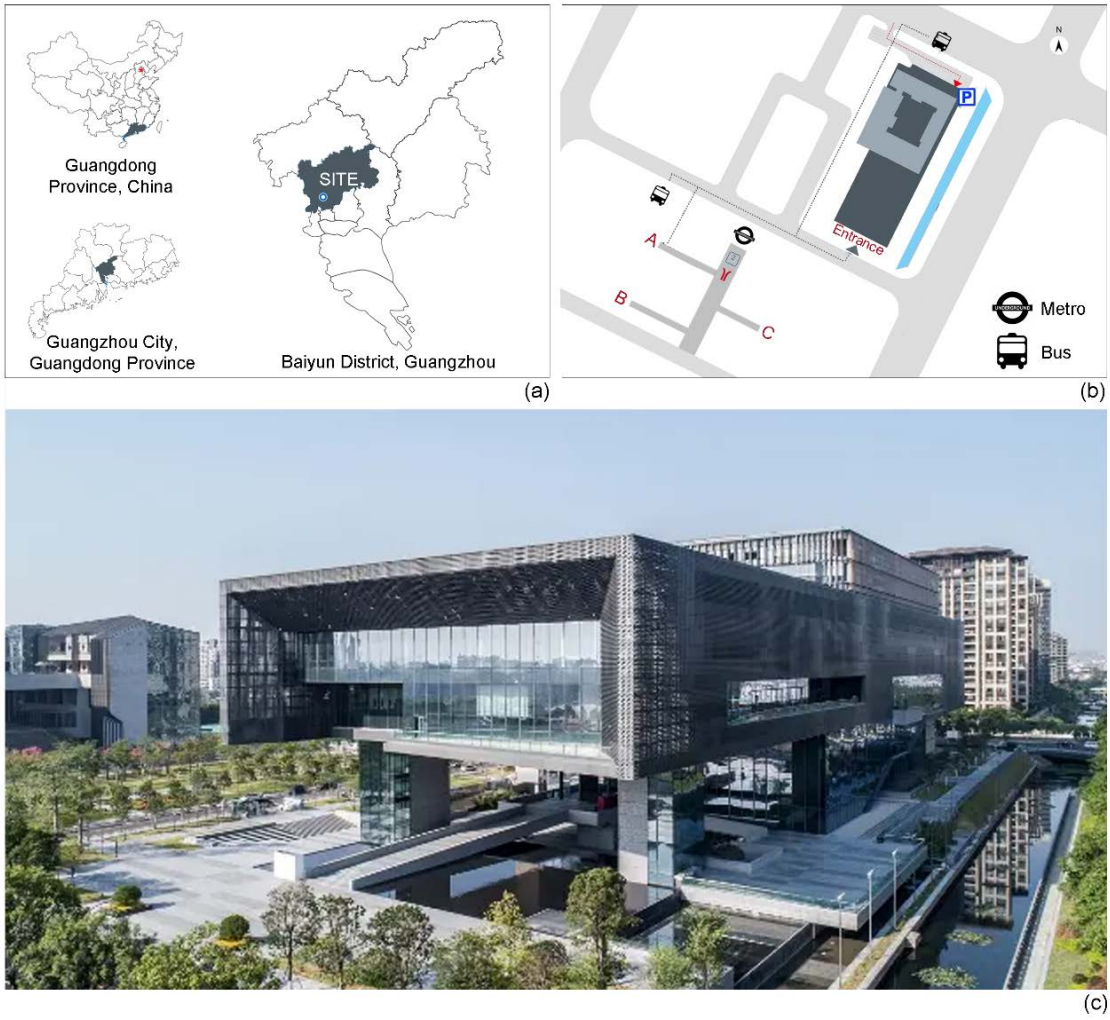

Figure 3 The Guangzhou UPEH

(a) Location of the Guangzhou UPEH; (b) Transportation and accessibility; (c) the Guangzhou UPEH

Source: (a) (b) produced by the authors and (c) online source by the architects from South China University of Technology

3.3 Sampling method

The research was conducted between October 8th and December 7th, 2019. The selection of participants was intended to be impartial and typical of Guangzhou UPEH visiting groups. Building on Falk and Storksdieck (2005), one adult out of every fifth

227 group of visitors that entered the UPEH entrance was approached and invited to
228 participate in the experiment. Participants could consist of one or more individuals,
229 only adults or adults with children. Overall, a non-biased sample of 115 adult visitors
230 participated in this study, thus achieving to capture approximately 15 % of the daily
231 flow, which can effectively represent the general visitor group (Conroy, 2018).
232
233 At the beginning the researcher provided a general overview of this study to the
234 participants. They were informed that their participation would be voluntary and that
235 they could withdraw from the experiment at any time. Those who agreed to participate
236 were asked to sign a consent form and were given further instruction on how to proceed.
237 To avoid 'demand bias' (Orne, 2009), in which participants may guess the research
238 objectives and state that their knowledge level has increased or that they purposefully
239 extended their visit, the researcher did not explicitly state that they would be asked to
240 answer the same question again, but rather stated that they would be asked some
241 questions after their visits. Following this process, participants were assigned to the
242 experiment group (n = 55) and control group (n = 60) at random. Their *personal*
243 information is listed in Table 3.
244

Table 3 Personal information of participants

Category	Division	Number	Percentage
Gender	Male	62	53.9%
	Female	53	46.1%
Age	18-34	73	63.5%
	35-54	31	27.0%
	55+	11	9.6%
Level of education	High school level or below	18	15.7%
	University level	70	60.9%
	Master's level or above	27	23.5%
Familiarity with the city	Visitors from outside Chinese mainland	4	3.5%
	Visitors from Chinese mainland	24	20.9%
	Local (stay in Guangzhou < 5 years)	23	20.0%
	Local (stay in Guangzhou >5 years)	64	55.7%
Occupation	Government official	8	7.1%
	Professionals/students in the built environment fields	16	14.2%
	Professionals/students in the media/interior field	13	11.5%
	Investor/businessman/policy-related	6	5.3%
	Others	70	61.9%
Motivation for visiting	Pursue new experience	5	4.6%
	Accompany friends and family	25	23.1%
	Learning knowledge of urban planning	36	33.3%
	A museum lover	9	8.3%
	For leisure	26	24.1%
	Others	7	6.5%
Prior knowledge	Self-assessed knowledge level of urban planning	1-5	100%
	Knowledge of factual information about urban planning	1-5	100%
	Breadth of knowledge in complex urban planning information	1-8	100%
	Depth of knowledge in complex urban planning information	1-5	100%

3.4 Data collection

3.4.1 Overall strategy

Building on Falk and Storksdieck (2005), Hein (2002), Hooper-Greenhill (2007) Bitgood (1993) and Bitgood et al., (1988), and in consultation with UPEH staff, data collection was performed before, during and after participants' visits to the Guangzhou UPEH (Table 1).

Before the visit: Four different types of knowledge acquisition measurements with varying complexity were used to get a comprehensive and robust understanding of participants' perception (Benyon, 2019): (1) a self-evaluation of participants' knowledge level of urban planning on a 5-point Likert scale; (2) nine structured questions focusing on factual information about Guangzhou's urban planning; (3) an open-ended test to examine participants' breadth and depth of knowledge in Guangzhou's urban planning; and (4) an open-ended question to examine additional learning gained from the UPEH (Hein, 2002; Hooper-Greenhill, 2007).

During the visit: Unobtrusive observation was performed during the visit for the experimental group (Falk & Storksdieck, 2005). Given the exhibition's popularity, enormous size and spatial layout, it was possible to maintain a sufficient distance from the participant to be unobtrusive. The observer first recorded the time spent by the participant at each exhibit, then documented their apparent interaction with others (e.g.,

267 determining the focus of their attention or observing whether specific members of the
268 party appeared to be leading the tour). Then, the level of interaction within the social
269 group and with UPEH guides outside the group was recorded. Finally, the total duration
270 of the visit (excluding entry and post-visit interviews) was recorded (Boisvert & Slez,
271 1994; Falk & Storksdieck, 2005).
272
273 After the visit: The questionnaire filled out by participants before their visit was shown
274 to them again. They were asked to re-assess their knowledge level of urban planning,
275 edit their responses to the structured questions if needed, complement their answers to
276 the open-ended test and describe any additional learning experiences they had
277 throughout the UPEH visit.
278

279 **3.4.2 Development of measurements**

280 **3.4.2.1 Dependent variables**

281 The dependent variable in this study is participants' learning from the UPEH, measured
282 using a combination of self-assessment, structured and open-ended questions (see
283 supplementary material Ⅲ). For the self-assessment question, participants were
284 enquired to specify their knowledge level of urban planning using a 5-point Likert scale,
285 ranging from 'none or minimal' to 'very high'. The structured questions, which
286 consisted of nine multiple-choice questions (each with one correct answer), designed
287 in consultation with the UPEH guides, indicated public's understanding of the basics

of urban planning in the city. Participants were tested on their knowledge of Guangzhou's historical layout, their ability to identify the city's most famous landmarks, their understanding of historical sites, and their comprehension of urban spatial strategic planning and the development of its transportation system (Sanchez & Afzalan, 2018).

The first open-ended question was intended to measure whether participants had a broad and extensive knowledge of urban planning in Guangzhou: 'Tell me everything you know about Guangzhou's history, present and future in terms of urban planning.' For further clarification this statement was added: 'Think about factors such as urban morphology, economic structure, landscape patterns, cultural heritage, city protection, transportation system, municipal facilities, environmental protection, etc.' (Sanchez & Afzalan, 2018). The second open-ended question, in accordance with GLOs (Hooper-Greenhill, 2007), asked participants what they had learned during their stay at the Guangzhou UPEH. These questions were followed by prompts around the dimensions of skills, interests, attitudes and emotions, and behavioural aspects.

3.4.2.2 Independent variables

Personal variables

As shown in Table 3, apart from basic socio-demographic variables including age, gender, level of education, and occupation, *personal* variables were incorporated such

as prior knowledge and visit motivations, based on museum visitor studies (Falk & Storksdieck, 2005). Measurement of participants' prior knowledge level included both self-assessment and a pre-visit knowledge test (see Section 3.4.2.1). Building on Falk and Dierking (2005), three reasons why participants come to the UPEH were identified: learning, entertainment and social bonding.

***Sociocultural* variables**

In general, *sociocultural* factors can be classified into two clusters: (a) interactions within one's own social group, and (b) interactions with people from the outside, such as staff members and other visiting groups (Falk & Storksdieck, 2005). Given the visitor profiles at UPEH, the *sociocultural* variables are divided into three categories (Table 4): whether the visitor was alone or in a group (e.g. with a child); whether the researcher was present during their journey through the UPEH; and whether their visit was influenced by the UPEH guide, either throughout the visit or in parts.

Table 4 *Sociocultural* variables of participants

Variable	Measure	Number	Percentage
Whether they come alone	Alone	29	25.2%
	In a group without children	65	56.5%
	In a group with children	20	17.4%
Whether the researcher is present	Experiment group (Group A)	55	47.8%
	Control group (Group B)	60	52.1%
whether they use a guide	With a guide throughout the whole process	14	12.4%
	With a guide occasionally during the visit	7	6.1%
	Without a guide	92	81.5%

Physical variables

We measured the physical variables of the exhibition design along two dimensions. The first relates to the exhibit exposure, what has also been referred to as 'attracting' and 'holding' power (Bitgood, 1993; Bitgood et al., 1988). These include the total time participants spent at the UPEH and the percentage of the visited exhibits during their stay.

The second dimension is concerned with the quality of the exhibit (Falk & Storksdieck, 2005). We asked a panel of three UPEH experts (a staff manager, a UPEH guide and an urban planner) who analysed the 119 individual exhibit components within the Guangzhou UPEH. Each expert rated the effectiveness of each exhibit on a scale of 1 (not at all) to 6 (very much) based on the following questions: Is it possible to learn from the exhibit? Is the interface user-friendly, is the planning information presented clearly, is the exhibit engaging, and, most importantly, will thorough engagement with the exhibit help a deeper understanding of the message the curators wishes to convey? These criteria were used to identify the top 10% and 25% exhibits in the UPEH. Participants engagement with these top-rated exhibits were coded based on unobtrusive observation techniques and documented in Table 5.

343 **Table 5 *Physical* variables of participants**

Category	Design of exhibits	Scale
Exhibit exposure	Total time seeing exhibits in the UPEH	0.13-4.5 h
	Total number of exhibits visited	9-64
Exhibit quality	Engagement with the top 10% exhibits in the UPEH	0.01-0.89h
	Engagement with the top 25% of exhibits in the UPEH	0.06-1.34h

344 ## 3.5 Data analysis and results presentation

345 Using descriptive analysis in IBM SPSS version 26.0, the *personal*, *sociocultural*, and
346 *physical* factors were examined. The participant's self-assessment value for their level
347 of knowledge was calculated using a 5-point Likert scale. Structured questions were
348 graded using the predetermined responses, with one point awarded for the correct
349 response and zero for the incorrect response. Data from the open-ended questions were
350 transcribed from the original interview data, listed in a word document and coded in
351 NVivo software following an inductive approach (Fereday & Muir-Cochrane, 2006).
352 These data were aggregated into different dimensions, measured in terms of breadth
353 and depth of answers (Falk & Storksdieck, 2005).

354

355 A sample of the measurement criteria and scoring process is provided in supplementary
356 material Ⅳ. Specifically, the number of conceptual categories put forth by participants
357 served as an indicator for the breadth of responses (Falk & Dierking, 2016). The scores
358 for the breadth of answers varied from 0 to 8, reflecting the exhibition's eight non-
359 overlapping categories. Depending on the level of sophistication and detail in the

responses within each conceptual category, the depth of responses was divided into six levels. A score of 0–5 was used, with the scores being none, very limited, somewhat limited, generally adequate, good, and excellent. The user information and scores were double-checked by a research assistant using the aforementioned standard.

After participants' scores were measured, the Shapiro-Wilk test was used to see if the distribution of the participants' scores across different parameters was normal. This was used to investigate the differences in learning outcomes pre- and post- their visit, as well as the influences on those learning changes (Field, 2013). Since the dependent variables were not distributed normally, the Wilcoxon Signed Ranks test was applied to investigate the mean difference of self-assessed levels and structured tests prior to and following their visit. Ordinal regression was applied to investigate the influences of different *personal*, *sociocultural* and *physical* factors on variations in their self-assessed knowledge level and responses to structured tests (Lu, 2021). For the first open-ended question, the Analysis of Covariance was utilised to distinguish mean differences between different independent factors (Field, 2013). For the second open-ended question, thematic analysis was applied to aggregate the different learning dimensions of participants (Fereday & Muir-Cochrane, 2006; Nowell et al., 2017).

4 Results

4.1 Comparing before and after a visit to the urban planning exhibition hall, is the participants' knowledge about urban planning improving?

All types of participants' knowledge tests improved significantly (Table 5). After their visits to the UPEH, participants' self-reported knowledge levels (M = 2.91) were, on average, 0.81 points higher than they were before ($p < 0.001$). After each visit, the average score of the structured tests improved from 4.08 to 5.98 ($p < 0.001$). The first open-ended question saw a substantial improvement in participants' scores, both in terms of depth and breadth. The mean breadth of their scores increased from 1.37 to an average of 2.55 out of eight exhibition themes in the post-visit evaluation ($p < 0.001$). After their visit, the participants' depth of responses increased from 2.85 to 6 on average ($p < 0.001$).

Table 5 Participants' knowledge acquisition before and after their visit

Pair Number	Content (Test items)	Before visit (Mean)	After visit (Mean)	After-Before (Mean)	Percentage change (%)
Pair 1	Self-assessed knowledge level	2.10	2.91	0.81	38.6*
Pair 2	Structured questions	4.08	5.98	1.90	46.6*
Pair 3	Breadth of knowledge	1.37	2.55	1.18	86.1*
Pair 4	Depth of knowledge	2.86	6.00	3.14	109.8*

'*' Indicates that a significant difference is detected

Regarding participants' learning experience after the visit to the Guangzhou UPEH, the NVivo coding results revealed five main categories, (1) knowledge and understanding, (2) skills, (3) attitudes and values, (4) enjoyment, inspiration and creativity; and (5) action, behaviour and progression.

Concerning knowledge and understanding, many participants mentioned that they gained a more systematic understanding about Guangzhou's development, water system and historical development (A14, A20, A26, A30, A35). Skills such as multi-media presentation techniques and curatorial design strategy were also frequently mentioned by participant (B26, B41).

In relation to attitudes and values, most participants were content with the Guangzhou City development (A9, A12, A26, B5). Many stated that it 'has increased their sense of belonging' (A29) or 'love of the city' (A32). Participants and UPEH employees (A15, B11, B31) also expressed appreciation towards the physical environment of the planning exhibition. As participant A15 (female, 70 years old) stated, the landscape surrounding the UPEH is very beautiful, and is offering attractive viewpoints to see the surrounding trees and mountains in the distance.

However, some questioned whether the city planning specifications presented would be realised as planned (A37, A48, A52). For example, A48 (male, 50 years old)

expressed some doubts regarding the somewhat utopian future presented by the urban planning exhibition, as he personally favours 'planning representation that is backed up by historical data'. Participants also provided suggestions in terms of marketing promotion, exhibition design and exhibition guidance systems (A8, A17, A25, A28, B29).

Concerning enjoyment, inspiration and creativity, many participants were happy to undertake the visit with family members, partners or friends (A15, B18). They were also feeling comfortable or content after the visit (B35). Regarding action and behaviour, participants agreed that they would not only recommend the urban planning exhibition to others, but would personally return for a second visit (A11, B44). Observations such as the intention to 'travel to the areas shown in the exhibits' were frequently discussed (B12).

4.2 What factors affect knowledge acquisition at the urban planning exhibition?

Personal factors (including age, gender, occupation, familiarity with the city and motivation for visiting) generally did not significantly affect participants' knowledge acquisition in the urban planning exhibition. Similarly, participants' *sociocultural* factors (such as whether they came alone, whether they used a guide and whether the researcher was present) did not affect their learning efficiency either. Participants' level

437 of education, prior knowledge, and *physical* factors including total length of visit, total
438 number of exhibits visited and engagement with the top-rated exhibits in the urban
439 planning exhibition, on the other hand, were significant indicators of changes in the
440 knowledge tests (see Table 6).
441

Table 6 *p* value showing the influence of personal, sociocultural, and physical factors on public's knowledge changes from different tests

	Category	Change in Self-assessed knowledge level	Change in Structured Questions	Change in Breadth of knowledge	Change in Depth of knowledge
Personal	Gender	0.953	0.133	0.662	0.847
	Age	0.146	0.247	0.616	0.667
	Level of education	0.341	0.471	0.045*	0.023*
	Familiarity with the city	0.255	0.199	0.737	0.527
	Occupation	0.073	0.732	0.434	0.128
	Motivation for visiting	0.105	0.667	0.888	0.626
	Prior knowledge	0.000**	0.001**	0.261	0.000**
sociocultural	Researcher presence	0.348	0.636	0.207	0.142
	Come alone or with a group	0.678	0.710	0.596	0.087
	With guide or not	0.245	0.230	0.103	0.257
Physical	Total length of visit in the UPEH	0.136	0.000**	0.361	0.681
	Percent of total exhibits visited	0.206	0.038*	0.564	0.05*
	Engagement scores with the top 10% exhibits	0.818	0.004**	0.711	0.8
	Engagement scores with the top 25% exhibits	0.890	0.003**	0.091	0.815

'*' Indicate that a significant difference is detected ($p < 0.05$) while '**' show that a significant difference is detected ($p < 0.001$)

On factual and self-assessment questions, people with less prior knowledge significantly improved; people with a higher level of prior knowledge were associated with an increased likelihood of learning more in-depth, complex information ($\chi 2(1) = 13.988$, $p < 0.001$). Participants who provided more accurate responses to the structured

451 questions were less likely to improve their factual knowledge, as evidenced by an odds
452 ratio of 0.959, $p = 0.008$. On the other hand, more time spent in the urban planning
453 exhibition was positively correlated with the probability that the structured questions
454 would get better, with an odds ratio of 5.640, $p < 0.001$.
455
456 A significant difference in mean breadth ($p = 0.045$) and depth of knowledge gain ($p =$
457 0.023) existed in relation to participants' responses to the open-ended questions after
458 their visits. Post hoc analysis using Bonferroni's test revealed that participants with
459 university-level education were more likely to gain a greater breadth of knowledge than
460 those of high school level education or below ($p = 0.043$). In relation to depth of
461 knowledge, a significant difference existed between participants educated at master's
462 level or above and at high school level or below ($p = 0.006$) and between participants
463 educated at undergraduate level and educated at master's level and above ($p = 0.017$).
464 Participants educated at master's level and above were more likely to deepen their
465 knowledge compared to those with a high school diploma or less and those with an
466 undergraduate degree.
467
468 The findings also revealed that the extent to what individuals learnt from the urban
469 planning exhibition was strongly affected by their *physical* context. Participants learned
470 more factual knowledge after a longer visit ($p < 0.01$). Participants who visited a variety
471 of exhibits were more likely to acquire more factual information ($p = 0.038$) and expand

their depth of knowledge ($p = 0.05$) compared to those who visited fewer exhibits. In addition, people who engaged more with the top-rated exhibits also learnt more compared to others who spent less time viewing the top-rated exhibits ($p < 0.01$).

5 Discussion

5.1 Knowledge acquisition in urban planning exhibitions

This research provides a comprehensive look at the role of urban planning exhibitions in planning communication. Through a repeated measure design approach, visitors' knowledge acquisition of urban planning improved significantly in terms of self-evaluation, structured tests and open-ended questions. This supports the UPEH's role for planning communication, according to the Chinese Association of Urban Planning (2007). The result was consistent with Fan (2014), Tan & Cho (2022), and Nakajima (2021), which discovered that visitors were pleased with the role of the urban planning exhibition in communication, as evidenced by post-visit ratings. The results quantitatively confirm prior studies that planning exhibitions can be used to explain past history as well as systemic challenges in urban planning (Freestone, 2015; Freestone & Amati, 2011), highlighting the potential of using urban planning exhibitions to involve the public in urban planning.

491 It was found that participants' learning from urban planning exhibitions is a multi-
492 dimensional experience more than knowledge itself. These include family and
493 friendship bonding, enjoyment, inspiration and creativity, attitudes, behaviours and
494 progressions, and skills. These support the five Generic Learning Outcomes (GLOs) as
495 stipulated by Hooper-Greenhill (2007). The research also adds to previous studies on
496 the role of urban planning exhibitions including political metaphor, economic branding
497 (Fan, 2014) or exhibition layout (Qian & Wu, 2012).
498

499 **5.2 Urban planning exhibitions for inclusive planning communication**

500 In line with the findings of Falk and Dirking (2005) and Bitgood (1993) in other
501 informal learning contexts, *personal* variables including age, gender, familiarity with
502 the city, motivation, and occupation had no significant impact on knowledge
503 acquisition in the planning exhibitions. *Sociocultural* variables, including the
504 composition of the visiting group, the presence of a guide, and the presence of a
505 researcher, did not significantly influence the outcome.
506

507 However, those visitors with little knowledge about urban planning before visiting
508 showed significant improvement on factual questions and self-assessment. A higher
509 level of education was linked to a higher likelihood of increasing the depth of more
510 complex information. Broadly speaking, this implies that people with diverse
511 backgrounds visiting urban planning exhibitions can improve their knowledge about

planning helped by visiting such specialized exhibitions. Overall, the results indicate that the urban planning exhibition, with its broad range of visualisation media and planning contents, could serve as a platform for inclusive learning for the general public (Lu, 2021).

5.3 Implications for urban planning theory and regulation

This study expands on Healey's (1996) communicative planning theory, which was developed when communication media for public engagement were less developed from a technological point of view. The study extends the Generic Learning Outcomes and Contextual Model of Learning theory from museum studies to the field of urban planning. The suggested theoretical framework for measuring influencing factors in effective planning communication would benefit user experience and evaluation studies in the planning discipline.

Some international and local planning regulations support publicizing the contents of urban planning through exhibitions, e.g. as expressed in the *Regulations on public announcement and publicity of urban and rural planning of the People's Republic of China* (Ministry of Housing and Urban-Rural Development of the People's Republic of China, 2013). Also, the *European Landscape Convention* mentions awareness-raising (Council of Europe, 2004) which is further detailed in the 'Recommendation CM/Rec(2008)3 of the Committee of Ministers' (Council of Europe, 2015) to

specifically include e.g. exhibitions, audiovisual means and simulations as a means for implementing the European Landscape Convention.

The fact that urban planning exhibitions delivered knowledge effectively lays the foundation for other countries to incorporate planning exhibitions as effective means of public engagement into mainstream planning and governmental processes.

However, there is significant potential to raise the profile and role of urban planning exhibitions in terms of communication and participation. Currently, most planning exhibitions are set up in a top-down way. Expert-driven views are the basis for communicating given contents of planning and design in a one-way direction. So far, a possible involvement of the general public is limited to the receiving end (Fan, 2014; Kochan, 2018). This may give the impression that possible future scenarios are fixed expressions of planning and design, while in fact they may still be fluid (c.f. Larkham and Lilley (2012). Given the urban planning exhibitions are often important strategies for city branding with considerable financial investments (Denton, 2013; Ma et al., 2020), rather than just having a focus on providing one-directional information, future planning legislation could explore the potential of urban planning exhibitions to be used in a more interactive way supporting dialogue between the experts and the public and helping to improve planning and design outcomes.

5.4 Implications for urban planning professionals

The nature and process of learning as it occurs within the urban planning exhibition context also provides guidance for how urban planning presentations can create better learning environments. In this study, participants' learning was affected by the *physical* context of their visit. Participants acquired a higher level of factual knowledge after spending more time in the UPEH; participants who visited a greater number of exhibits were able to achieve a better understanding of urban planning. In addition, participants who spent more time with exhibits of higher levels of sophistication (i.e., interactiveness, design etc.) enhanced their knowledge better than others. This indicates that urban planning practitioners should focus on retaining visitor attention to enhance learning effects, and on maximising the variety of exhibits that are able to hold attention in this way (Lu et al., 2020).

Professionals engaged in the design and communication of urban planning contents should take into account the influence of physical displays and user characteristics on public perceptions of urban planning, adjusting the curatorship to meet diverse needs. Possible dimensions include the interactiveness of visualisation tools (Danahy, 2001; Lindquist & Campbell-Arvai, 2021; Rainoldi et al., 2018), the content of planning information (Lu et al., 2020), and the education level and prior knowledge of users. Notably, each planning exhibition is characterised by a unique visiting pattern, with a distinctive kind of movement, which is strongly influenced (though not determined) by

574 the layout of spaces and exhibits (Zhao, 2021). Future studies can further examine the
575 impact of these factors on the cognitive gains of the visitors.

576 6 Conclusion

577 This research was set out to examine the role of urban planning exhibitions in
578 communication. Using the case of the Guangzhou UPEH, a repeated measures design
579 approach with 115 participants was used to analyze knowledge change before and after
580 participants' visits. Results confirmed the role of planning exhibitions to enhance public
581 understanding of urban planning in a variety of knowledge forms. This research draws
582 upon the Generic Learning Outcomes and Contextual model of Learning theory,
583 quantitatively expanding on communicative planning theory in assessing the efficiency
584 of planning communication. The research shows that *personal* and *sociocultural*
585 contexts had little influence on self-assessment and factual understanding about urban
586 planning, showing the potential of incorporating planning exhibitions as an inclusive
587 learning platform for the general public. *Physical* contexts including visiting length,
588 number of exhibits seen by the participants, as well as engagement with top-rated
589 exhibits were found to significantly influence participants' learning. This calls for an
590 active and deliberate design of the planning exhibitions.
591
592 The limitation of this study lies in the following two aspects. First, sample selection.
593 As each journey can take up to 2-4 hours, it is very time-consuming to further increase

the number of participants. Second, this research primarily examined whether people's knowledge of urban planning increased shortly after visiting urban planning exhibitions. One of the primary features of short-term memory is that it is subject to temporal decay or forgetting. Future studies could therefore examine the public's understanding of urban planning over a longer period of time.

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