

# Retention in a Series of Online Symposia with Tangible 3D Models for the Visually Impaired: Survival and Cohort Analyses for Accessible Edutainment Outreach

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## Abstract

This paper examines retention in an episodic, semiannual online symposium series on 3D learning for the SDGs that combines Zoom-based delivery with tangible learning aids for accessible outreach. Using attendance records from 10 online symposia (S2–S11;  $N = 784$ ), retention is analyzed with Kaplan–Meier survival estimation, duration distributions, cohort retention, and a comparison between blind and low-vision (BLV) and non-disabled registrants. Overall retention shows a steep early drop: 526 participants (67.1%) attended exactly one symposium, while 198 (25.3%) attended the final observed symposium and are right-censored. At the same time, re-engagement is substantial: 135 of 258 repeat attendees (52.3%) returned after skipping at least one symposium. The group-disaggregated analysis shows that BLV registrants were markedly more persistent than non-disabled registrants, with higher survival across attended events, higher next-session retention (40.6% vs. 16.5%), and a larger repeat-attendance share (54.8% vs. 24.7%). Although MOOC completion rates are only a reference and not a direct analogue, the BLV retention profile is notably stronger than the high-attrition baselines commonly reported for online learning. These findings suggest that webinar-based participation, when paired with tactile access pathways such as mailed 3D models, can sustain participation particularly well for BLV learners while still leaving important tactile, logistical, and first-session design challenges unresolved.

## CCS Concepts

• **Applied computing** → **Education**; • **Human-centered computing** → **Accessibility**; *Interaction design*.

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## Keywords

retention; survival analysis; cohort analysis; online symposium; tangible learning; blind and low vision; accessibility; 3D model

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## 1 Introduction

The broader design space of tangible and immersive approaches for accessible, meaningful education highlights two approaches that may look different but share a goal: accessible and meaningful education. **Tangible interfaces** enable hands-on manipulation of physical artifacts, supporting multisensory learning and often benefiting learners with visual impairment, motor difficulties, or low digital literacy. **Immersive technologies** (VR/AR/MR) can provide guided learning spaces and remote access when physical materials are hard to distribute. In practice, many accessible learning experiences are *hybrids*: an online or immersive layer broadens participation, while tangible artifacts enable embodied understanding.

At the same time, **retention** remains a fundamental challenge for online learning. Large-scale online courses often report attrition around **85–90%** (10–15% completion) [11, 18]. While a symposium series is not a course, such baselines clarify that dropout magnitudes in online settings are commonly high and that the first-session experience is pivotal.

This paper examines retention in a multi-year outreach program: a semiannual symposium series on 3D learning for SDGs that shifted to **Zoom-based delivery** and intentionally supported accessibility for BLV participants. The series is distinctive in two ways that motivate different analysis choices than typical online education:

- (1) **Episodic (non-cumulative) topics.** Each symposium is self-contained and does not assume prior attendance. This can reduce the cost of re-entry after absence, but it may also weaken incentives to attend consecutively.
- (2) **Semiannual cadence.** With roughly six months between events, short-term engagement dynamics differ from weekly courses and can increase the chance that returning requires

a renewed decision rather than habit. Importantly, this cadence and the non-cumulative structure plausibly *increase* the probability of dropout compared with weekly courses, because routines and social momentum are harder to sustain across long gaps.

See Section 3 for the symposium structure (episodic, semiannual) and the tangible artifact distribution workflow.

The goal is not to “compete” with MOOCs as a learning format; rather, this paper seeks an evidence-based characterization of retention for *accessible, episodic online learning events about tangible/3D content*. Such characterization is directly relevant to the broader design space of tangible and immersive approaches for accessible, meaningful education: if online delivery is used to widen access to tangible learning, organizers need to understand where participation is lost and what event design features might mitigate dropout.

This paper follows two earlier publications reporting the design and initial evaluation of this symposium format: PETRA ’23 documented the first implementation of an online tactile/3D symposium for BLV audiences [14], and PETRA ’25 reported its general efficacy as a medium for BLV participants [15]. Building on those studies, the present paper addresses a longitudinal question central to sustainable accessible education: how retention unfolds over multiple years in an episodic, semiannual series, and what this implies for tangible and immersive learning environments.

## 1.1 Research Questions

This study frames retention in this setting with four research questions aligned to the broader design space of tangible and immersive approaches for accessible, meaningful education:

- RQ1:** What is the overall retention pattern of an **episodic, semiannual** online symposium series that combines online delivery with tangible learning aids?
- RQ2:** How does retention vary across **entry cohorts** (participants who first attend a given symposium), given long inter-event intervals and non-cumulative topics?
- RQ3:** How do retention patterns differ between blind/low-vision registrants and non-disabled registrants in this episodic, semiannual online symposium series?
- RQ4:** What accessibility-related factors help explain retention behavior, particularly for BLV participants, when the event is online (Zoom) yet the subject matter involves **tactile/tangible** understanding?

## 1.2 Contributions

This study makes three contributions. First, it provides an empirical retention analysis of 10 online symposia (S2–S11; N=784 participants) in a program that explicitly targets accessible 3D/tactile learning. Second, it offers a methodological template that adapts Kaplan–Meier survival analysis and cohort retention to episodic, semiannual events with right-censoring. Third, it derives actionable implications for accessible and meaningful learning systems that combine online participation with tangible interaction, emphasizing both benefits and structural limits for BLV learners.

## 2 Background and Related Work

### 2.1 Online learning retention as a baseline comparison

MOOC research provides a rough baseline for interpreting dropout magnitudes. Completion rates in MOOCs are often reported around 10–15%, implying 85–90% attrition [11, 18]. This setting differs (no grades, no formal completion certificate, topic-driven attendance), so these numbers are not a direct comparator; they are used only as context for what “high dropout can look like in online learning.

### 2.2 Survival and cohort approaches to retention

Retention can be modeled as time-to-event data, where the event is dropout. Kaplan–Meier estimators [12] provide a nonparametric survival function, and Cox models [6] allow covariate analysis when explanatory variables are observed. Survival analysis is especially useful for engagement studies because (i) participants can enter at different times, and (ii) data collection commonly ends while some participants remain active (right censoring).

Cohort retention complements survival analysis by grouping participants by entry time and measuring return rates at subsequent opportunities. In episodic events, cohort analysis is intuitive: it answers whether a first-time attendee at symposium  $S_k$  returns for  $S_{k+1}$ ,  $S_{k+2}$ , etc., even when calendar time between those opportunities is long.

### 2.3 Tangible and multisensory learning for accessibility

Tangible interfaces connect digital concepts to physical manipulation [10] and are shaped by physical space and social interaction [9]. Embodied and grounded cognition perspectives argue that cognition is linked to perception and action [3, 21], and multisensory learning evidence suggests benefits for robustness and efficiency [19]. For BLV learners in particular, tactile and multisensory access can replace or complement visual information and support meaningful participation in online events. For 3D-printed tactile models in particular, prior work shows that physical 3D artifacts can support concept formation and discussion through hands-on exploration, and that teachers can collaboratively design and adapt 3D printed models to make otherwise visual content accessible to BLV learners [4, 7, 20].

### 2.4 Zoom-based online events for BLV participants: benefits and limits

Online participation can lower travel barriers and enable broader inclusion. A comparative study of disabled people’s experiences with video conferencing tools reports that Zoom is often preferred but that accessibility still varies by task and configuration [8]. For users with visual impairment, a study comparing Zoom and MS Teams identified accessibility limitations and learning-feature gaps, and proposed design recommendations using accessibility standards and Universal Design for Learning perspectives [1, 5]. Importantly, accessibility is not only a participant-side issue: BLV meeting facilitators may encounter barriers related to host controls, moderation, and managing accessible workflows [2]. In this symposium series,

the primary organizer and lead author is totally blind, which makes these facilitator-side barriers a lived and practical design constraint rather than an abstract consideration.

For events about 3D or tangible content, there is an additional structural constraint: video conferencing can transmit audio/captions and visuals, but it cannot by itself provide tactile exploration of physical artifacts. This tension is central to the broader design space of tangible and immersive approaches for accessible, meaningful education and motivates the present study: Zoom can be “particularly beneficial” for BLV learners in terms of participation access, yet tactile access must be designed and supported separately.

### 3 Case: 3D4SDGs Semiannual Symposium Series

#### 3.1 Program overview

The 3D4SDGs symposium series targets broad audiences (education, accessibility, sustainability) and focuses on 3D models, tactile learning, and SDGs-relevant themes. After the initial symposium (S1) held in-person, the program shifted to online delivery using Zoom. Each symposium includes talks and discussion around a theme. In all sessions, organizers encourage tactile engagement by introducing physical artifacts or 3D models that participants can touch (e.g., 3D-printed objects, tactile graphics). Namely, by shipping 3D models to interested registrants in advance, tactile access during the online symposium was made possible [14, 15]. This approach is the defining feature of this series of symposia.

#### 3.2 Study scope and sessions

Online symposia S2–S11 (10 sessions) are analyzed. S1 was held in February 2020 at an in-person venue in Tokyo, with 55 on-site participants, and is mentioned here only as a reference point for the subsequent online series. Later sessions (e.g., S12) exist in the broader series but fall outside the observation window.

Table 1 summarizes the analyzed sessions and registrant counts (participants with at least one attendance record for that session). The symposium series welcomes participation from both BLV and non-disabled participants. Earlier reports also noted that tactile exploration of 3D models attracted interest from non-disabled participants as well as BLV participants [14, 15]. The revised analysis below therefore treats between-group comparison as part of the main results rather than as contextual background.

Interest from non-disabled participants far exceeded the authors’ initial expectations. As reported in the preceding paper, the participant composition in each symposium remained roughly stable across the series, with BLV participants accounting for slightly less than half and non-disabled participants accounting for slightly more than half of attendees [15].

To illustrate participation dynamics at the session level, Figure 2 plots per-session registrant counts.

A linear regression of per-session registrant counts against symposium index indicates a statistically significant upward trend (slope=7.84 registrants per session,  $R^2=0.70$ ,  $p=0.0025$ ), suggesting that registrations increased over time despite the episodic, semiannual cadence.

**Table 1: Online sessions analyzed (S2–S11) and registrant counts.**

S2	2020-08-08	The importance of touch in the COVID era	132
S3	2021-02-06	Messages from touch	100
S4	2021-08-13	Now and next for tactile experiences	136
S5	2022-02-05	Exploring beauty through touch	151
S6	2022-08-11	As a BLV, how I use 3D models	169
S7	2023-02-11	Tactile model tour across Japan (1)	153
S8	2023-08-05	Touching the intangible	179
S9	2024-02-03	Tactile model tour across Japan (2): Space challenges	181
S10	2024-08-24	Touch and talk our challenges	158
S11	2025-03-22	Touch and understand the frontier	198

## 4 Data and Operational Definitions

### 4.1 Dataset

The dataset is a participant-by-session registration matrix for S2–S11, with binary attendance indicators. It contains  $N=784$  unique participant IDs. Any recorded registration is treated as participation. Participants were identified as the same person using the email address they used to register. However, this alone would treat specific participants as different individuals if they registered using different email addresses for each session. Therefore, when similar email addresses were observed, names were verified, and if they belonged to the same person, those entries were merged. Additionally, instances were observed where registrants shared information like the Zoom URL with their acquaintances. Issues were confirmed where these acquaintances, who did not register directly, participated in the sessions. These instances involved only a few individuals per session and did not significantly impact the analysis, so they were disregarded. Identifiers were anonymized before analysis.

### 4.2 Defining retention for episodic, semiannual events

Because the series is episodic and semiannual, “retention” is not naturally measured as weekly persistence. Two complementary operationalizations are therefore used:

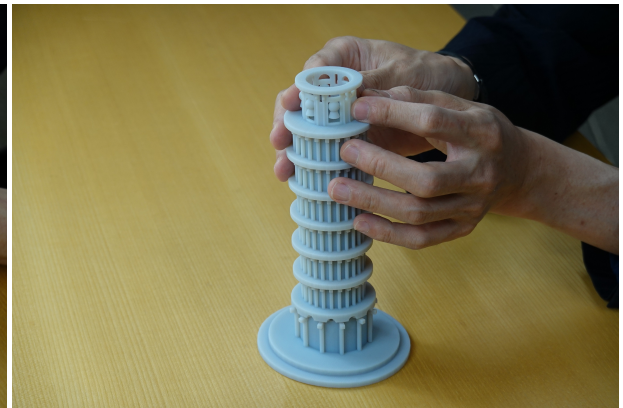
(1) *Survival in number of attended events.* Each participant’s *duration* is defined as the number of symposia they registered during the observation window. Dropout is operationalized as having no further attendance observed after the final attended symposium *within* the window.

*Right censoring.* Participants who attended the final observed symposium (S11) are right-censored because whether they would return after S11 is not observed. Importantly, some participants attended only S11; these cases are censored at duration 1, which affects early survival estimates.

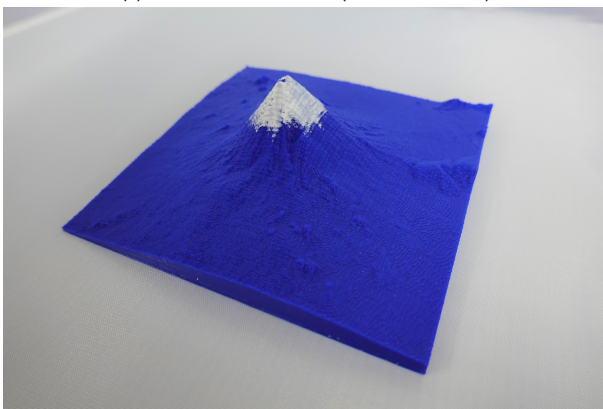
(2) *Cohort retention over the series sequence.* Participants are grouped by their first attended symposium (entry cohort), and retention at subsequent opportunities is computed: T+1 is the fraction of the cohort that attends the next symposium, T+2 the fraction



(a) Tactile virus model (delivered at S2)



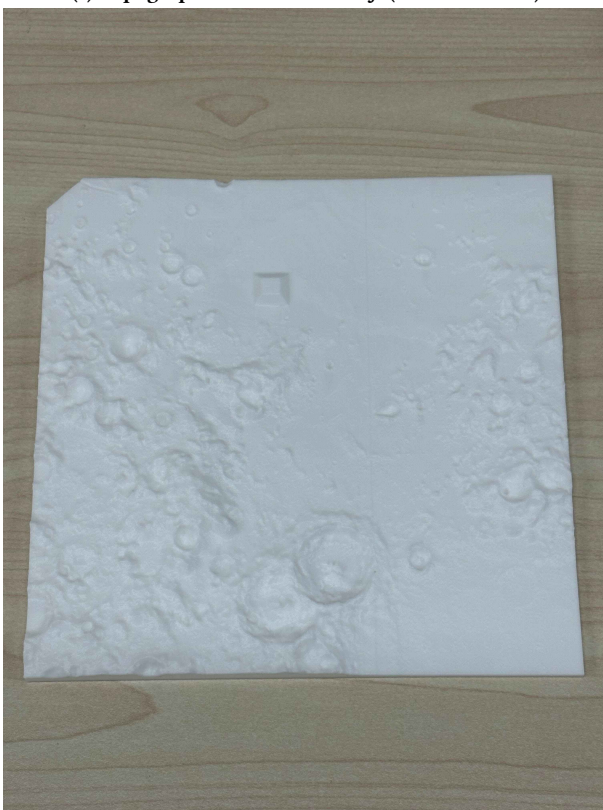
(b) Leaning Tower of Pisa (delivered at S3) [13]



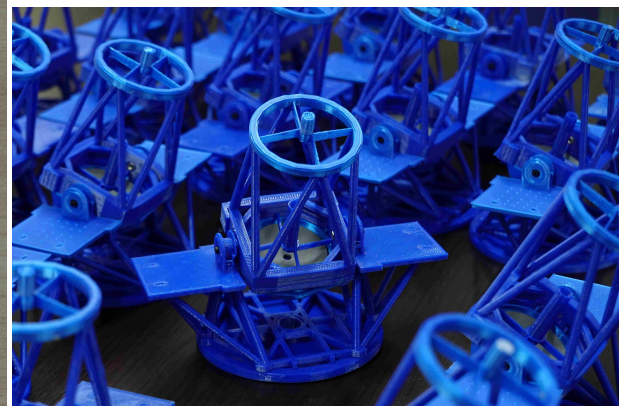
(c) Topographic relief of Mt. Fuji (delivered at S5)



(d) DNA double helix (delivered at S5)

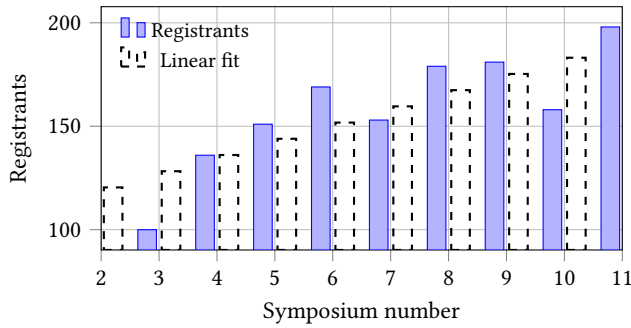


(e) Lunar surface model (delivered at S9)

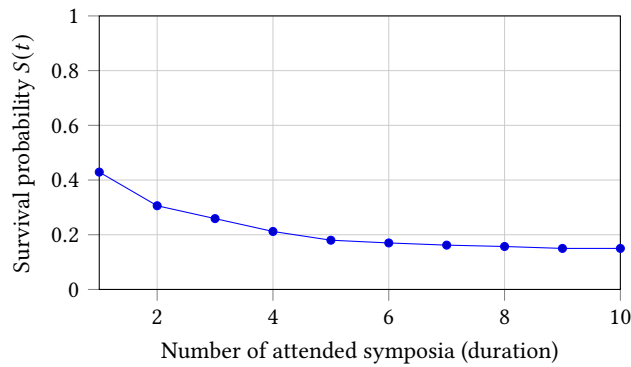


(f) Array of Telescope models for shipping (delivered at S10)

Figure 1: Examples of 3D models used in the symposium series (reused from the PETRA 2023[14] and PETRA 2025[15] papers).



**Figure 2: Registrants per symposium (S2–S11).** Bars show distinct registrants per session; dashed line shows a linear fit (slope=7.84 registrants/session,  $R^2=0.70$ ,  $p=0.0025$ ).



**Figure 3: Kaplan–Meier survival curve over the number of attended symposia.** Dropout is defined as not attending S11; attendees of S11 are right-censored.

attending the one after that, and so on. This aligns with how participants encounter semiannual opportunities.

## 5 Methods

### 5.1 Kaplan–Meier estimation

The survival function  $S(t)$  over  $t \in \{1, \dots, 10\}$  attended events is estimated using the Kaplan–Meier estimator [12]. An “event observed” is treated as not attending S11. Attendance at S11 indicates the participant is still active at the end of observation and is censored.

### 5.2 Duration distribution

To make the survival curve interpretable for practitioners, the empirical distribution of durations (how many symposia a participant attended) is also reported.

### 5.3 Cohort retention

For each entry cohort (S2–S10), T+1 retention and the latest observed T+k retention within the window are computed. Cohorts closer to S11 have fewer follow-up opportunities.

**Table 2: Distribution of registrant durations (number of registered symposia within the window).**

Duration	Registrants	Share
1	526	67.1%
2	102	13.0%
3	40	5.1%
4	37	4.7%
5	22	2.8%
6	15	1.9%
7	10	1.3%
8	9	1.1%
9	14	1.8%
10	9	1.1%

**Table 3: Cohort sizes and retention.** T+1 is the fraction returning for the next symposium. “Latest” reports the last observed T+k within the window.

Entry cohort	Cohort size	T+1 retention	Latest observed retention
S2	132	28.8%	50.0%
S3	62	41.9%	59.7%
S4	66	25.8%	43.9%
S5	79	24.1%	41.8%
S6	84	16.7%	23.8%
S7	60	20.0%	33.3%
S8	82	17.1%	29.3%
S9	82	11.0%	14.6%
S10	59	30.5%	30.5%
S11	78	—	0.0%

### 5.4 Re-engagement after gaps

Because topics are independent, participants may skip sessions and later return. These topics correspond to the per-session themes listed in Table 1, which range widely (e.g., cultural heritage, astronomy, and molecular-scale concepts) and thus differ substantially from one session to the next. The analysis computes whether each repeat registrant shows a 1–0–1 pattern across the series (attend, skip, attend later). This re-engagement metric captures a kind of retention that is meaningful for episodic programs even when immediate consecutive attendance is low.

### 5.5 BLV and non-disabled group-disaggregated analysis

Initially, the symposium series was expected to attract primarily blind and low-vision participants, and participation by a larger number of non-disabled registrants than BLV registrants was not anticipated at the time of form design. Because disability status can constitute sensitive personal information, the registration form did not require it as a mandatory field. Instead, an optional checkbox asking whether the registrant was blind or low vision was included as a practical item related to the mailing of tactile models. For the group-disaggregated analysis, participant email addresses were used to classify registrants into three groups: BLV, non-disabled, and unknown. After consolidation, the resulting counts were 250

BLV registrants, 489 non-disabled registrants, and 45 unknown registrants. The inferential comparisons reported in RQ3 focus on the BLV and non-disabled groups, while the unknown group is retained in the full dataset but excluded from direct between-group tests. BLV is a particularly small and rare population even within the broader category of disability as a minority. Research on BLV participants therefore tends to take the form of qualitative studies focused on particular individuals. In this context, the present paper, which analyzes data from 250 BLV registrants, is expected to have a distinctive significance.

The same retention framework was then applied separately to the BLV and non-disabled groups. This included group-specific Kaplan-Meier estimation over number of attended symposia, group-specific duration distributions, and group-specific cohort retention profiles. To test between-group differences, the analysis compared overall duration distributions with a two-sided Mann-Whitney U test, next-session and related binary return indicators with two-sided Fisher’s exact tests, and the two survival curves with a log-rank test. In line with the presentation of the overall retention analyses above, the resulting group-comparison figures, tables, and numerical findings are reported in Section 6 rather than in the Methods section.

## 6 Results

### 6.1 RQ1: Overall retention

Figure 3 shows a steep early drop and a long tail.

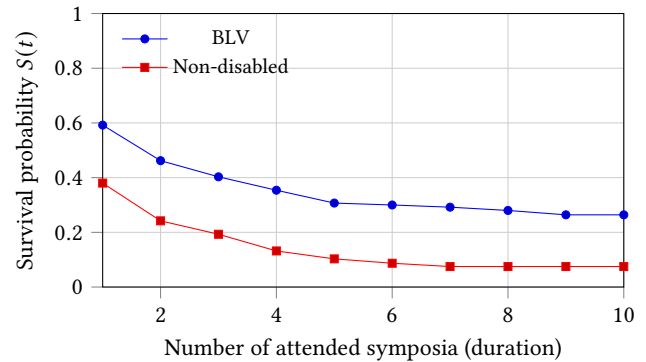
*Observed dropout and censoring.* Out of 784 registrants, 586 (74.7%) are observed to drop out before the final symposium, while 198 (25.3%) registered S11 and are right-censored.

The organizing team, including authors, has focused solely on the increase in participant numbers based on the findings of the preceding paper [15] and the trends shown in the Figure 2. As demonstrated in this paper, this increase stems from a total of 784 registrants, reflecting both the attrition of many past participants and the influx of new attendees. This fact was not recognized by the organizing team, and symposium planning did not take it into account.

*Early drop and the “90%” context.* A majority of registrants (526 / 784 = 67.1%) attended exactly one symposium. Among them, 448 (57.1%) attended once and did not return within the window (observed single-event dropout), while 78 (9.9%) attended only the final symposium and are censored. The magnitude of this early attrition is consistent with the intuition from online learning baselines, where high dropout (often framed around 90%) is common [11, 18]; however, this event-based setting lacks course incentives and should be interpreted as *topic-driven engagement* rather than course completion.

*Long tail and “core” participation.* Although median duration is 1 attended event, the tail of repeat participation is non-trivial. Table 2 shows that 32.9% of registrants attended two or more symposia. In addition, 198 registrants (25.3%) attended S11, indicating an active audience at the end of the observation window.

*Interpreting the tail under an unfavorable retention prior.* Because the series is episodic and held only twice per year, participants must re-discover the event and re-commit after long gaps, without



**Figure 4: Kaplan-Meier survival curves by participant group. BLV registrants remain above non-disabled registrants across the full duration range.**

the cumulative incentives typical in weekly courses. Under this prior, the observed long tail (32.9% attending 2+ sessions) and end-of-window active audience (25.3% at S11) suggest comparatively strong sustained value for a subset of participants, despite high early attrition.

### 6.2 RQ2: Cohort differences

Table 3 shows cohort heterogeneity. T+1 retention ranges from **11.0% (S9 cohort)** to **41.9% (S3 cohort)**. This suggests that immediate return may depend on factors that vary by symposium, such as theme salience, accessibility arrangements, outreach channels, speaker lineups, or competing events.

Because the series is semiannual, the cost of returning is not “keeping up weekly” but rather re-committing after a long gap. Cohorts with higher T+1 retention may have benefited from particularly resonant themes or from accessibility practices that reduced the cognitive cost of participation. Conversely, cohorts with lower T+1 retention may indicate that the first-session value was insufficient or that access barriers reduced satisfaction for particular audiences.

### 6.3 RQ3: Differences between blind/low-vision and non-disabled registrants

*Overall retention differs substantially by participant group.* The BLV group comprised 250 registrants, while the non-disabled group comprised 489 registrants. Observed dropout before the final symposium was lower in the BLV group (167/250, 66.8%) than in the non-disabled group (376/489, 76.9%). Conversely, attendance at the final observed symposium (S11), treated as right-censoring, was higher among BLV registrants (83/250, 33.2%) than among non-disabled registrants (113/489, 23.1%). Figure 4 shows that the BLV survival curve lies above the non-disabled curve at every observed duration, and the difference is statistically significant (log-rank  $\chi^2 = 45.32, p = 1.67 \times 10^{-11}$ ).

*Early attrition is markedly lower among BLV registrants.* Single-attendance participation was much less common in the BLV group than in the non-disabled group. Only 113 of 250 BLV registrants

**Table 4: Duration distribution by participant group.**

Duration	BLV <i>n</i>	BLV share	Non-disabled <i>n</i>	Non-disabled share
1	113	45.2%	368	75.3%
2	35	14.0%	67	13.7%
3	21	8.4%	19	3.9%
4	20	8.0%	17	3.5%
5	17	6.8%	5	1.0%
6	9	3.6%	6	1.2%
7	9	3.6%	1	0.2%
8	9	3.6%	0	0.0%
9	11	4.4%	3	0.6%
10	6	2.4%	3	0.6%

(45.2%) attended exactly one symposium, compared with 368 of 489 non-disabled registrants (75.3%). Among BLV registrants, 102 (40.8%) attended once and did not return within the observation window, whereas the corresponding figure for non-disabled registrants was 303 (61.9%). This indicates that the steep early drop observed in the overall sample is driven disproportionately by the non-disabled group.

*BLV registrants show a much stronger long tail of repeated participation.* The BLV group attended an average of 3.04 symposia (95% CI [2.72, 3.37], median = 2, IQR = 1–4), whereas the non-disabled group attended an average of 1.54 symposia (95% CI [1.43, 1.66], median = 1, IQR = 1–1). This difference was statistically significant (Mann–Whitney U,  $p = 1.93 \times 10^{-20}$ ), with a moderate-to-large effect size (Cohen’s  $d = 0.80$ , Cliff’s  $\delta = 0.35$ ). Consistent with this, 54.8% of BLV registrants attended two or more symposia, compared with only 24.7% of non-disabled registrants. Table 4 shows that BLV registrants are more broadly distributed across longer durations, whereas non-disabled registrants are concentrated heavily at duration 1. The contrast is not marginal: by duration 10, the survival estimate remains 0.264 for BLV registrants but only 0.075 for non-disabled registrants.

In the authors’ preceding paper [15] (see especially its Table 2 and Figure 4, noting that participant counts differ slightly because of differences in aggregation procedures), the per-session participant composition was reported to remain roughly balanced across the series, with BLV participants accounting for slightly less than half and non-disabled participants accounting for slightly more than half in each symposium. At first glance, this may appear inconsistent with the total registrant counts reported here, namely 250 BLV registrants and 489 non-disabled registrants, with the latter being nearly twice the former. However, once the substantially higher retention and repeated participation of BLV registrants documented above are taken into account, no substantive inconsistency remains.

*Immediate return is also higher among BLV registrants.* For registrants whose first participation occurred before S11, next-session (T+1) retention was 40.6% (97/239) in the BLV group and 16.5% (70/424) in the non-disabled group. This difference was statistically significant (Fisher’s exact test,  $p = 1.89 \times 10^{-11}$ ). More broadly, return at any later symposium after the first participation was observed for 54.8% of BLV registrants and 26.3% of non-disabled registrants, again indicating that BLV participation was not only

more frequent overall but also more likely to continue after the first contact.

*Cohort heterogeneity exists in both groups, but BLV cohorts remain consistently higher.* As in the overall analysis, retention varied across entry cohorts. However, BLV cohorts showed consistently higher T+1 retention than non-disabled cohorts. Among BLV cohorts, T+1 retention ranged from 18.8% (S9 cohort) to 57.1% (S3 cohort), whereas among non-disabled cohorts it ranged from 6.5% (S9 cohort) to 29.4% (S3 cohort). Table 5 shows that this pattern extends across the sequence of cohorts rather than being driven by a single entry period. This suggests that cohort-specific factors such as symposium theme, outreach, and accessibility arrangements affected both groups, but the BLV group maintained a systematically higher probability of return across cohorts.

*The BLV survival profile is also clearly stronger than MOOC reference baselines.* This cross-group result is important not only internally to the symposium series but also relative to online-learning attrition baselines. As a reference only, MOOCs often report 10–15% completion and therefore roughly 85–90% attrition [11, 18]. The present series does not measure course completion, so the comparison is not like-for-like. Even so, the BLV curve in Figure 4, the 54.8% repeat-attendance share, and the 40.6% next-session return rate indicate substantially stronger persistence than would normally be expected under those high-attrition online baselines. This strengthens the interpretation that the hybrid combination of online access and tactile support created a particularly durable value proposition for BLV participants.

*Re-engagement remains common in both groups, but has a different meaning.* Among repeat attendees, 67 of 137 BLV registrants (48.9%) returned after skipping at least one symposium, compared with 68 of 121 non-disabled registrants (56.2%). Thus, gap-return behavior is common in both groups, supporting the interpretation that this semiannual series is used episodically rather than sequentially. At the same time, because repeated participation itself is much more common in the BLV group, the absolute number of BLV registrants who formed a sustained, episodic audience was similar to that of the much larger non-disabled group.

#### 6.4 RQ4: Episodic format and accessibility considerations

*Accessibility interpretation should be grounded in the between-group results.* The between-group differences reported in RQ3 provide an important starting point for interpreting accessibility in this symposium series. Because BLV registrants were more likely than non-disabled registrants to return, both immediately and over the longer term, accessibility should not be understood here only as a barrier or deficit. Rather, the pattern suggests that the online symposium format may have delivered a form of value that was especially meaningful for BLV participants.

*Re-engagement aligns with episodic participation.* Among repeat attendees (2+ symposia), 135 of 258 (52.3%) returned after at least one skipped symposium. This supports the interpretation that participation is interest-driven rather than sequential: many participants treat the series as a set of independent opportunities rather

**Table 5: Cohort retention by participant group. T+1 is the fraction returning for the next symposium. “Latest” reports the last observed T+k within the window.**

Entry cohort	BLV <i>n</i>	BLV T+1	BLV latest	Non-disabled <i>n</i>	Non-disabled T+1	Non-disabled latest
S2	49	46.9%	32.7%	83	18.1%	10.8%
S3	28	57.1%	42.9%	34	29.4%	5.9%
S4	28	46.4%	28.6%	38	10.5%	5.3%
S5	28	42.9%	21.4%	51	13.7%	9.8%
S6	32	28.1%	25.0%	50	10.0%	4.0%
S7	18	38.9%	44.4%	42	11.9%	7.1%
S8	13	46.2%	38.5%	32	25.0%	25.0%
S9	32	18.8%	12.5%	46	6.5%	8.7%
S10	11	45.5%	45.5%	48	27.1%	27.1%
S11	11	—	0.0%	65	—	0.0%

than a course requiring consecutive attendance. For evaluation, this implies that episodic programs should track both consecutive return and re-engagement. The same interpretation is consistent with the BLV/non-disabled comparison above, where both groups exhibited gap-return behavior, even though repeated participation itself was more common among BLV registrants.

*Zoom is beneficial but not sufficient for tangible understanding.* The RQ3 results suggest that Zoom-based online delivery likely reduces a key participation barrier for BLV learners: travel. Prior work shows that disabled users often benefit from the flexibility of video conferencing and may prefer Zoom in practice [8]. At the same time, studies identify accessibility limitations and learning-feature gaps for visually impaired users [1] and barriers that BLV facilitators encounter with host controls and moderation [2]. In this symposium series, the primary organizer and lead author is totally blind, which makes these facilitator-side barriers a lived and practical design constraint rather than an abstract consideration. These issues can directly affect the experience of an online symposium (e.g., navigating Q&A, accessing shared materials, using chat, or interpreting slide-heavy talks).

*Tactile access remains a distinct design requirement.* For a symposium series about 3D/tangible content, there is an additional domain-specific constraint: **tactile access**. Even if the online platform is accessible, participants cannot “touch” a model through Zoom. Therefore, online delivery should be seen as a participation enabler, not a complete accessibility solution. The stronger retention observed among BLV registrants suggests that combining Zoom with mailed tactile artifacts can create a meaningful accessibility advantage. At the same time, the persistence of substantial early attrition even within the BLV group indicates that online accessibility alone is not sufficient, and that the first-session experience must still deliver immediate and tangible value. These interpretations remain inferential rather than causal, because the dataset does not contain survey responses, shipping indicators, or direct measures of why particular participants returned or dropped out.

## 7 Discussion and Implications for Tangible and Immersive Accessible Learning

### 7.1 Contrasting paths: tangible vs. online/immersive

To current knowledge, combining (i) the physical delivery of tactile 3D artifacts and (ii) synchronous, Zoom-based online symposia as a recurring format is still uncommon, which limits direct comparison with prior event designs. However, this absence of close comparators also reflects that the format occupies an under-explored design space: it can make participation feasible through online access while preserving the tangible, hands-on qualities needed for meaningful BLV edutainment. The retention evidence presented here is therefore best understood as an initial benchmark for future work that may compare tangible-by-mail, local hub distribution, and fully virtual alternatives.

The results can be interpreted through the broader design space of tangible and immersive approaches for accessible, meaningful education. Online or immersive access widens participation by reducing geographic and mobility barriers, a point that is consistent with prior work on video conferencing accessibility and disabled users’ participation preferences [1, 5, 8]. At the same time, tangible access remains central to meaningful learning for spatial and 3D content, especially for BLV participants, and prior work on tactile and 3D-printed artifacts suggests that physical exploration plays an important role in concept formation, discussion, and collaborative adaptation for accessible learning [3, 4, 7, 9, 10, 19–21]. Taken together, the present results suggest that retention depends on aligning both dimensions. The steep early drop indicates that the first symposium experience must be immediately valuable and accessible; otherwise, participants are unlikely to return after a six-month gap. In hybrid tangible+online programs, this alignment includes both platform accessibility and the availability, timing, and quality of tactile experience.

An important substantive result is that BLV registrants were not merely slightly more persistent than non-disabled registrants; their survival curve was clearly higher across the full duration range, and their repeat-attendance share was more than twice as large. Although MOOC completion rates are only a reference and not a direct analogue, this BLV retention profile is also markedly more

favorable than the high-attrition baseline often reported for large-scale online learning [11, 18]. This point matters for the paper’s broader argument: in accessible tangible learning, online delivery should not be viewed only as a compromise forced by distance, but also as a format that can, when paired with tactile access pathways, sustain longitudinal participation particularly well for BLV learners.

*Why the semiannual, episodic format makes retention harder.* Weekly courses benefit from short feedback loops, social presence, and habit formation. In contrast, a semiannual cadence stretches the interval between opportunities, raising the chance that participants forget, priorities change, or accessibility setups lapse. Likewise, an episodic (non-cumulative) format removes the obligation to “keep up” and can weaken the perceived cost of dropping out. Therefore, the default expectation is that retention would be at least as challenging—and plausibly more challenging—than in many weekly online courses. Against this backdrop, the persistent tail and frequent gap-based re-engagement (52.3% of repeat attendees) indicate that a portion of the audience finds recurring, renewably meaningful value.

## 7.2 Design recommendations

The first attended symposium should be treated as the primary conversion point. Given the strong early attrition, organizers should provide clear accessibility guidance, accessible materials, captions, and explicit narration of visual content from the outset. Episodic re-entry should also be supported through accessible summaries, recordings with structured descriptions, and concise “what you missed” materials, because the main challenge in this format is re-commitment after a long gap rather than weekly continuity. When tactile understanding is central, Zoom should be paired with tangible access strategies such as mailed 3D models, local pickup, or shared local hubs, because related work indicates that tactile artifacts are not merely supplementary but often central to meaningful BLV engagement with spatial content [4, 7, 20]. Host-side accessibility must also be operationalized through keyboard-accessible moderation, clear turn-taking, accessible Q&A, and explicit slide descriptions, in line with prior work on disabled users’ video-conferencing experience and facilitator-side accessibility barriers [1, 2, 8, 16].

A further practical implication concerns sustainability. A tangible-by-mail format can create distinctive value, but it also requires printing, packing, postage, inventory management, and lead time. For wider adoption, organizers may need to prioritize which sessions truly require mailed artifacts, reuse model sets where appropriate, seek sponsorship or institutional subsidy, or combine postal distribution with local hubs and partner organizations. Without this operational layer, the pedagogical value of tactile access may be difficult to sustain over time even when the online format itself scales well.

## 7.3 Limitations and future work

This study uses participation as a coarse proxy for engagement. It does not measure learning outcomes, motivations, shipping receipt, accessibility configuration, or direct reasons for dropout, and disability status is available only through a non-mandatory registration item rather than a controlled research instrument. Accordingly,

the accessibility interpretations in RQ4 should be read as theoretically informed explanations grounded in participation patterns rather than as direct causal tests. Future work should link retention to symposium-level features such as theme, speakers, and specific accessibility interventions; measure perceived value and barriers via post-event surveys or interviews, including BLV participants; compare hybrid tangible+online events against immersive alternatives such as VR with haptics within the broader design space of accessible learning; and model retention with richer covariates using approaches such as Cox regression when the necessary explanatory variables are available [6].

This paper clearly showed the high retention rate of BLV participants. It is necessary to investigate the reasons for this high retention rate from multiple perspectives, including the genre of each session theme and the nature and comprehensibility of the 3D models that were distributed.

Because such a high level of interest from non-disabled participants had not been anticipated, data were not collected in a way that would allow participants to be classified rigorously into BLV and non-disabled groups. For a more precise understanding, it would be desirable in future symposia to revise the data collection methods used in registration, while giving the highest priority to the protection of personal information, and also to develop more refined approaches to the analysis of past symposium data.

## 8 Conclusion

This paper analyzed retention in an episodic, semiannual online symposium series that combines Zoom-based delivery with tangible learning aims for accessible SDGs-themed edutainment outreach. Using survival and cohort analyses over 10 online sessions (N=784), the results show steep early attrition (median duration 1) alongside a long tail of repeat participants. The most theoretically important result is the high level of gap-based re-engagement: 135 of 258 repeat attendees (52.3%) returned after skipping at least one symposium. This pattern indicates that retention in episodic accessible learning events cannot be understood only as immediate next-session return. The revised group-disaggregated analysis further shows that BLV registrants were more likely than non-disabled registrants to return both immediately and over longer intervals, and that their survival profile was markedly stronger than the high-attrition baselines often cited for MOOCs, although that reference is not directly analogous. Taken together, these findings refine how retention should be interpreted for episodic accessible learning events and strengthen the claim that accessible online delivery paired with tactile access can create unusually durable value for BLV participants within the broader design space of tangible and immersive approaches for accessible, meaningful education. Zoom-based participation can be highly beneficial for BLV learners, but meaningful education about tangible or 3D content still requires deliberate tactile access pathways and sustainable operational support beyond videoconferencing alone.

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