TEMPORAL VISUALIZATION OF BODY CAVITY PARTITIONING: An Interactive Timeline

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Abstract

Embryology is essential for future health-care providers to understand due to clinical significance, since birth defects and prematurity are leading causes of disability and infant mortality. The lack of embryology visualizations presents a barrier to discovering embryonic relationships quickly and efficiently. A web-based, interactive timeline on body cavity partitioning was developed to allow users to discover key developmental landmarks of both normal andabnormal embryonic development. Body cavity partitioning was chosen as the area of focus, as organ system development is directly related to the embryonic spaces. Users can select events, which highlights related structures and defects with visual cues.

Background

Embryology:
Human embryology, or the first 8 weeks of development, presents a unique challenge to learn and teach due to the dynamic nature of developmental structures. Because the amount of time devoted to embryology during class time is reduced, much of this material must be self-taught [1,2].
Body cavity partitioning incorporates all three germ layers and integrates developing structures in both the thoracic and abdominal cavities. This portion of embryology particularly ideal for visualization as current resources separate information by body systems.

Timelines:
Timelines are an effective visual communication device that can be used to chronologically organize relationships between types of events such as social interactions, history, movie narratives, data or information visualization, and court or medical cases. One advantage of using interactive timelines includes providing a larger context for events to enable users to compare and analyze potential relationships [3].

Interactivity:
Interactive computerized modules have a positive effect on learning and are well received as supplemental learning tools for medical education concepts [4]. In addition, computer-based visualization can be used for integrating large amounts of data in an understandable way [5]. A visual solution can provide the user an accessible way to interact with developing structures in context, determine which events occur simultaneously recognize their effects on each other, and observe how a disrupted event could result in a defect.

Objectives

The objectives are to determine the effect of the utilization of an interactive timeline on:
1) the amount of time needed for students to identify key developmental landmarks and their connection to embryonic defects in body cavity partitioning
2) knowledge gain after timeline use
3) the quality of user experience and usability while uncovering temporal relationships

Materials & Methods

Workflow

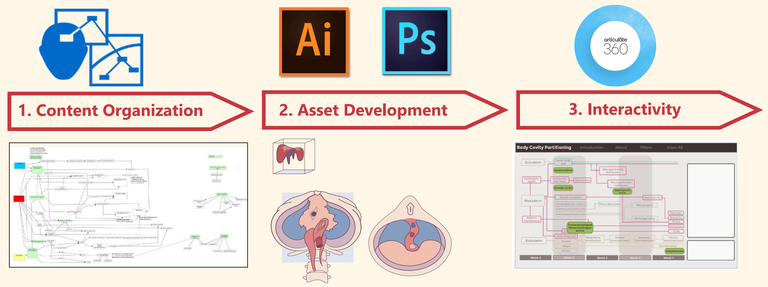


Fig. 1 Flowchart of workflow 1) Embryology content was organized with Cmap Tools to create a flowchart of only the most essential embryology information 2) Representational images were created with Adobe Photoshop and Illustrator 3) Interactive elements were designed with Articulate 360

User Interface

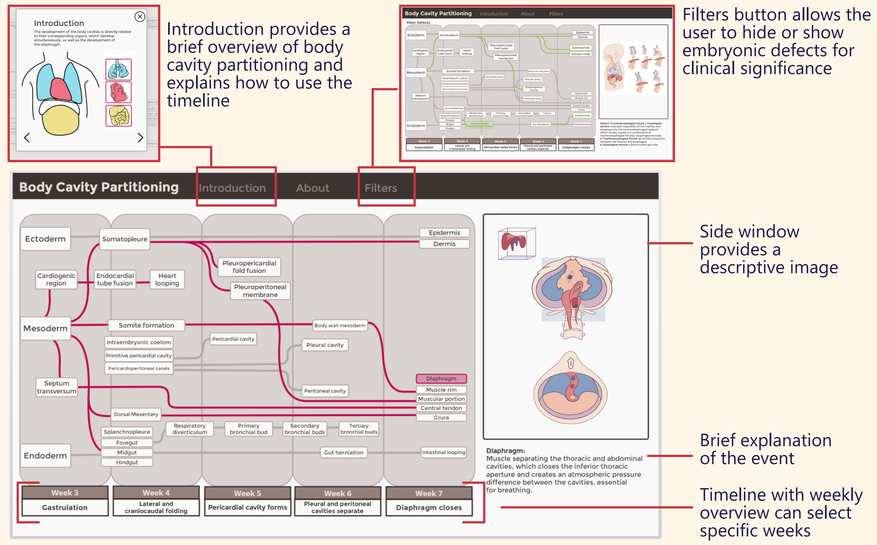


Fig. 2. Overview of the features of the timeline. By pressing an event button, any related developmental structures will be highlighted by connected links, illustrating relationships.

Testing

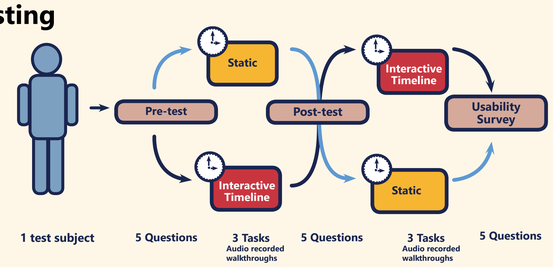
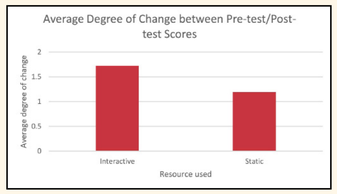


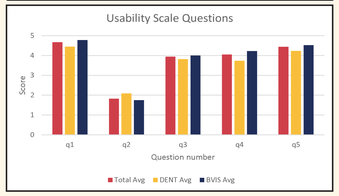
Fig. 3 Flowchart of cross-over study design: Subjects were tested with both the static and interactive timeline to account for individual variability.

Results



Graph I: Average degree of change between the pre-test / post-test scores after interactive and static resources use. Scores increased by an average of 1.72 points (out of 5) in subjects given the interactive resource first, and 1.19 points in those given the static resource first.

Graph II: Average time in seconds for subjects to complete 6 tasks using static and interactive resources. 2/6 tasks were completed more efficiently with the interactive timeline. This may have been caused by questions without exact phrasing, and a difficulty finding the filters button.



Graph III: Subjects were asked to rate the interactive timeline on a scale from 1 to 5:
1= strongly disagree; 5= strongly agree. On average, the timeline recieved a score of 4/5 for ease of use and efficiency. Q2 asked if particiapants felt the timeline was unneccesarily complicated.

Thirty-four subjects participated in the study; 11 dental students, and 23 biomedical visualization students. Subjects' post-test scores increased with both resources; however, only two of the six distributed tasks were completed more efficiently using the interactive resource.

Discussion & Conclusions

An easily accessible web-based interactive was an effective method for displaying large amounts of embryonic, time-based data. After the timeline was distributed, users were able to complete tasks in several minutes. Using an interactive timeline helped to improve student knowledge of both normal developmental relationships and congenital abnormalities that occur during the embryonic period.

This research adds to a limited amount of existing data on the effectiveness of interactive timelines in education, as well as providing evidence for the possibility that this method is appropriate to help students learn embryonic relationships. The research also aims to address the ongoing issue of lack of embryology education in the medical school curriculum and the lack of resources available for students learning embryology online.

Bibliography

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