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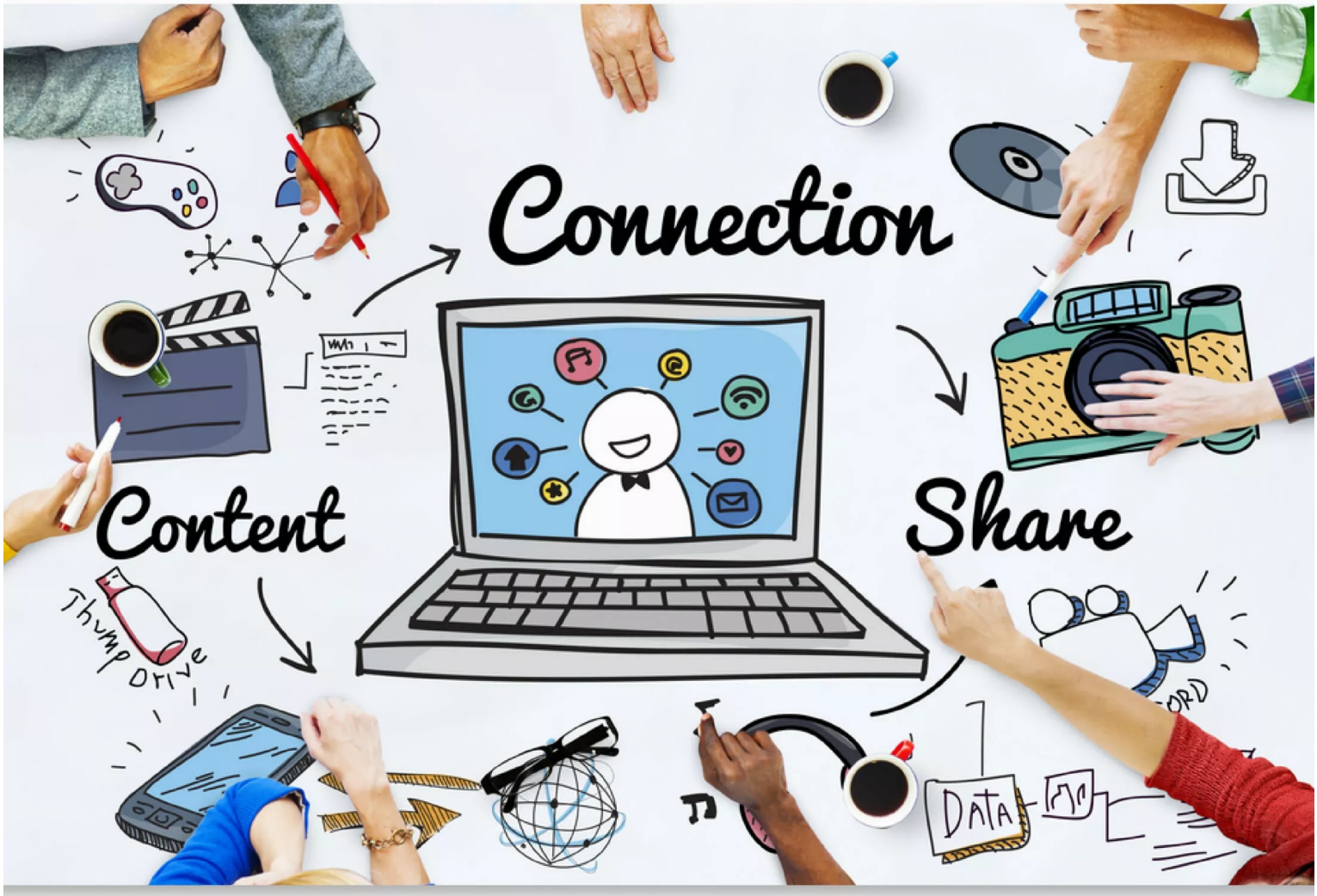

Appropriate Use of Media in Teaching and Learning

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Media in education refers to ***any communication tool or resource*** used to support teaching and learning. These are channels through which educators deliver information and learners receive and interact with educational content.

Educational media predominantly comprises of :

Traditional Media:	Digital Media:
• Printed materials: textbooks, handouts, workbooks • Whiteboards and chalkboards • Physical models and demonstrations • Charts, posters, and photographs	• Text-based media : e-books, journals, and online resources • Visual media : medical illustrations, infographics, videos and animations • Audio media : recorded lectures, podcasts and audio books • Digital presentations and slideshows • Online learning platforms • Interactive software and applications • Virtual and augmented reality

Multimedia refers to the ***integration of multiple forms of media*** - text, graphics, audio, video, animations, and interactive elements - to facilitate teaching and learning. These can be easily stored and carried in a pen drive, CD or hard disk.

> *"If we teach today as we taught yesterday, we rob our children of tomorrow."*
> *– John Dewey*

For decades, medical educators have relied on conventional teaching tools like textbooks, anatomical models, and clinical demonstrations. This article primarily explores the evolving landscape of digital media and their appropriate use in medical education.

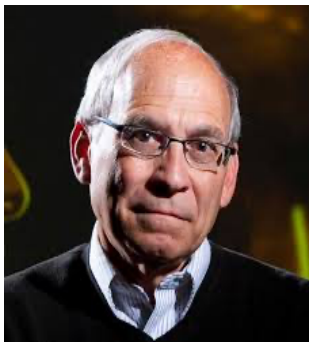
Benefits of using digital media in education:

- **Improved Understanding**: Visuals, animations, and videos can break down complex concepts into more digestible components, making them easier for students to grasp and retain.
- **Increased Engagement**: The interactive nature of digital content actively engages learners, helping them maintain their focus and interest throughout the learning process.
- **Flexibility**: Media allows self-paced and remote learning opportunities.
- **Catering to Multiple Learning Styles**: Media appeals to auditory, visual, and kinaesthetic learners.
- **Real-World Applications**: Digital tools like case studies, simulations, and augmented or virtual reality create immersive learning experiences that closely replicate real-world scenarios, bridging the gap between theory and practice.

Appropriate use of media :

The appropriate use of media in education involves leveraging various forms of tools to enhance teaching and learning experiences while ensuring that the methods align with educational objectives, learner needs, and ethical considerations. There are many theories for effective use of multimedia, but the one from Richard Mayer is the most respected in educational literature.

Mayer's Multimedia Principles: These are guidelines for creating effective educational materials that combine words and images. These principles are based on how the human mind processes information and are particularly effective in educational settings where complex information needs to be conveyed clearly and memorably.



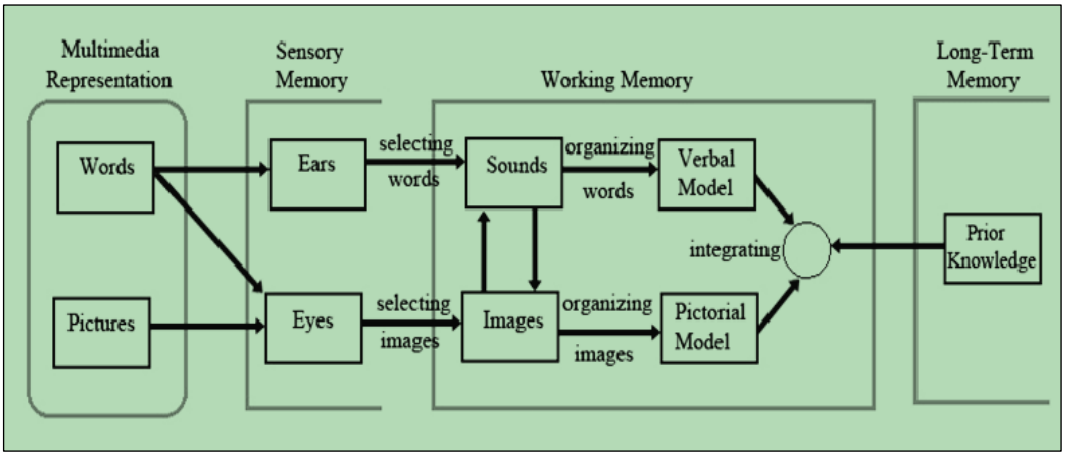
Sir Richard Mayer

Multimedia learning comprises of three important cognitive processes:

a) **Selection :** channelling of auditory inputs (words, narrated text) to the verbal system while visual inputs (images) go to the visual system.

b) **Organisation:** Orderly arrangement of the selected auditory and visual information to create verbal and pictorial models respectively in the learner's mind

c) **Integration:** Connecting the verbal and pictorial models with each other and with prior knowledge



Reference : Mayer (2008)

Based on the above theory, the key principles of multimedia were outlined as follows:

1. Multiple representation: People learn better from words and pictures together than from words alone.
2. Spatial Contiguity: Learning is enhanced when related words and pictures are presented near each other rather than far apart.
3. Temporal Contiguity: People learn better when corresponding words and pictures are presented simultaneously rather than successively.
4. Coherence: Learning improves when extraneous material is excluded rather than included.

5. Signalling: Learning improves when essential material is highlighted or cued.
6. Redundancy: Learning is impaired when the same information is presented in multiple forms unnecessarily (e.g., text and narration duplicating the same content)
7. Segmenting: People learn better when a lesson is presented in user-paced segments rather than as a continuous unit
8. Pre-training: People learn better when they know the names and characteristics of the main concepts.

PowerPoint Presentations:

The most common multimedia tool used in a medical classroom is a Power Point Presentation (PPT). A component of Microsoft® PowerPoint® software, it combines text, images, drawing features, and other objects to create self-running or interactive displays to support or enhance formal lectures. Each file created by PowerPoint is called a presentation and each presentation is made up of slides. While creating an effective presentation, one should always be cognizant of the Mayer's principles.

Application of Multimedia Principles Relevant to Clinical Biochemistry Educators	
Coherence	• Remove unnecessary molecular details that do not contribute to core concept understanding • Focus on clinically relevant aspects of pathways • Avoid overcrowding diagrams with non-essential information
Multiple representation	• Combine visual graphs with narration of biochemical processes • Attach images relevant to inborn errors of metabolism alongside explanation of key clinical features
Redundancy	• Avoid duplication of the same content in text and narration
Spatial contiguity	• Place explanatory text directly adjacent to relevant graphs

	• Keep key learning points close to the visual representation • Present reference ranges alongside test results
Temporal contiguity	• Use narration at the same time the image of a biochemical process is being shown • Demonstrate time-based processes (like OGTT) with synchronized explanations
Signaling	• Incorporate color-coding to distinguish between normal and pathological values • Highlight key enzyme reactions in metabolic pathways
Segmenting	• Break down complex biochemical pathways into manageable steps • Present one concept at a time (e.g., separate modules for different metabolic processes)
Pre-training	• Establish basic concepts before moving to complex interactions/regulatory pathways/ clinical correlation. • Handouts of slides may be given apriori to sensitise students for this purpose. • Provide reference ranges before discussing clinical cases with laboratory values

Technical tips for creating an effective PPT:

1) ***Use 'Sans Serif' Fonts:*** The fonts are of two types, serif and sans serif. Serif type is preferred for the printed word while the sans serif type (which means 'without' serif) is applicable for electronic media. The serif is a small tail added to the ends of letter strokes as a decoration and helps to guide the vision of the reader along the line (e.g. *'Times New Roman'*, *'Book Antiqua'* and *'Centaur'*). The sans serif type being of a uniform thickness throughout is much easier to read when projected on a screen (e.g. *'Arial'*, *'Helvetica'* and *'Tahoma'*).

2) ***Limit to Two Font Types:*** Use a maximum of two different clear and reasonably bold fonts during the entire presentation, one for the headings and the other for the remaining text, rather than multiple font styles.

3) ***Use a minimum 24 Point Size Font:*** Ensure your text is easily readable by using a minimum font size of 24 points for main content and 36 points for titles. While you can vary

font sizes to emphasize key points, use such variations sparingly. Also, consider the size of the classroom while deciding on font size.

4) ***Avoid CAPS:*** When a word is in capitals, the eye is presented with a rectangular shape that is more difficult to read and less intuitive. It is also not a must that the titles be in capitals. Instead, use sentence case, which combines upper and lower case letters naturally.

5) ***Follow the Rule of Six:*** To maintain clarity, follow the "Rule of Six" - limit each slide to six lines with no more than six words per line.

6) ***Avoid cluttering the slides:*** Keep your slides focused by presenting just one concept per slide. Include only essential text that isn't covered in your narrative, and ensure any text appears alongside relevant images on the same slide.

7) ***Colours:*** For visual appeal and readability, maintain a consistent colour scheme throughout. Choose high-contrast combinations - either dark text on a light background (preferably white or off-white) or light text (white or yellow) on a dark background (like blue). Limit each slide to four colour regions maximum and be cautious with textured backgrounds as they may display differently across systems.

8) ***Adding pictures:*** Pictures and graphics may be incorporated into presentations to make them livelier and more interesting. While images can enhance your presentation, ensure they serve a purpose rather than being mere decoration. Use space-efficient file formats like JPEG or GIF instead of larger formats like BMP to keep your presentation file manageable.

9) ***Adding animations:*** Animations can help build complex ideas gradually, overcoming the static nature of traditional slides. However, use them judiciously - too many animated elements can distract from your message and extend your presentation time unnecessarily.

10) ***Adding videos:*** Video content can be particularly effective for demonstrating procedures or showing real-life situations. Videos are especially valuable for teaching clinical signs and symptoms in medical contexts and can be powerful tools for changing audience attitudes, particularly in AETCOM classes.

"The most powerful element in any PowerPoint presentation isn't on the slides at all - it's the space you create for your audience to think, feel, and connect with your message."

Professor Laura Stevens, Communication Studies

Use of other digital media:

The dynamic world of medical science demands that every Indian Medical Graduate embrace the role of a lifelong learner. To achieve this, students must cultivate self-directed and collaborative learning skills early and consistently apply them throughout their medical training. Faculty, in turn, must become proficient in digital educational tools to guide students effectively and integrate these tools into curriculum design and assessment methods. This approach ensures that medical graduates are not only well-versed in their subject matter but also equipped with the critical learning skills necessary for ongoing professional growth.

A plethora of digital tools are available as online platforms and applications. Some of them are delineated below:

- **E learning :** E-learning in medical education combines two key approaches: ***synchronous learning***, involving real-time virtual interactions like live online lectures and case discussions, and ***asynchronous learning***, featuring self-paced content like recorded lectures and interactive modules. While synchronous learning enables immediate interaction and feedback, asynchronous learning offers flexibility and self-directed study opportunities.
- **MOOCs :** Massive Open Online Courses (MOOCs) have revolutionized medical education by providing large-scale, accessible and cost-effective learning opportunities to healthcare students and professionals worldwide. These platforms offer structured courses which do not have any pre-defined restrictions or qualifications (i.e. open). They cover various medical topics, from basic sciences to specialized clinical knowledge. MOOCs feature video lectures, interactive assessments, discussion forums, and peer learning opportunities. The SWAYAM portal (Study Webs of Active Learning for Young Aspiring Minds) initiated by the Government of India offers many such MOOCs.
- **OER :** Open Educational Resources (OER) are freely accessible, openly licensed educational materials which can be used, reused and shared. These resources include digital textbooks, clinical case libraries, virtual patient simulations, anatomical models, and assessment tools. Both students and healthcare professionals benefit from unlimited access to learning materials, self-paced study options, and diverse learning resources. Libre Texts - comprehensive biochemistry textbooks and modules, Biochemistry Free For All - digital textbook by Oregon State University,ChemTube3D - free molecular visualization tools are some examples of OER related to Biochemistry.

- **Virtual collaborative learning tools:** These tools leverage technology to simulate group discussions, problem-solving sessions, and knowledge sharing in a virtual space. Examples are Zoom, Microsoft Teams, Google Workspace, Padlet, virtual whiteboard, social media etc. They enable students and facilitators to share perspectives, clarify doubts, and develop critical thinking skills.
- **Simulations** : Augmented Reality (AR) and Virtual Reality (VR) serve as an important digital tool in modern medical education by providing a risk-free environment for clinical skill development. Through virtual patients, anatomical models, and procedural simulations, medical students can practice complex procedures, diagnostic reasoning, and emergency responses without endangering real patients. These tools allow for repetitive practice, immediate feedback, and standardized learning and assessment experiences.
- **AI tools:** AI tools are transforming medical education by enhancing learning through advanced algorithms and personalized experiences. Adaptive platforms like Smart Sparrow adjust to individual learning needs while AI chatbots like ChatGPT by Open AI and Gemini by Google provide instant clarifications on complex topics.

Best practices for media use in education:

1. **Alignment with learning objectives:** Media should support specific learning goals, whether for conceptual understanding, skill development, or critical thinking.
2. **Integrate, do not overwhelm**: Use media to complement traditional methods rather than replace them entirely.
3. **Learner-centred design:** Consider the learners' needs, backgrounds, and preferences when choosing media formats.
4. **Engagement and interaction:** Use media that promotes active learning, such as interactive videos, simulations, or quizzes.
5. **Usability**: Ensure the chosen media works smoothly across devices and platforms.
6. **Train educators and learners**: Provide training on effectively using educational media tools.
7. **Ensure privacy and security**: Adhere to data protection laws, particularly when using online tools.
8. **Evaluate effectiveness**: Collect feedback and assess whether media use is improving learning outcomes.

Challenges related to digital media use:

Several challenges must be addressed when implementing educational media. Technical limitations, including inadequate infrastructure and unreliable internet access in certain regions, can create barriers to effective media use. Digital literacy of both learners and educators are vital for success of learning endeavour. There's also a risk of overreliance on digital tools, which may reduce valuable face-to-face interactions and hands-on learning experiences. Additionally, poorly designed or inappropriate media content can become a source of distraction rather than enhancement, potentially compromising the learning process. Ethical concerns, especially patient-related content, requires strict adherence to privacy and consent protocols.

"In medical education, media should serve as a bridge, not a barrier. Choose tools that enhance learning rather than complicate it. The best technology is the one that becomes invisible in service of understanding."

Professor James Martinez, Digital Learning Innovation

Conclusion :

The appropriate use of media in education transforms traditional learning into an interactive, inclusive, and effective process. When carefully selected and implemented, media can enrich learning experiences, making education more engaging and accessible while preparing future healthcare professionals for clinical and academic challenges.

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