

Interactive Journal Club: Teaching an Old Dog New Tricks

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ABSTRACT: The interactive journal club incorporates basic principles of active and adult learning in a traditional education tool to maximize opportunity to develop critical thinking, communication skills, active reflection, and personal confidence in these skills. Following the choice of an appropriate article, the Designated Leader (DL) directs the discussion by presenting the title and data from the article with instructions for their analysis but without the author's text. The participants, except the DL, are viewing the article for the first time and are prompted in their review of the raw data to provide their own interpretation, discovery, and critique. Participants are challenged to become more adept at study design, data analysis, and presentation and have indicated by informal verbal feedback that they look forward to the interactive journal club as it is enjoyable, relevant, and beneficial. Implementation of the interactive journal club does not require significant training in the approach or extensive revision or preparation of course materials.

KEYWORDS: Journal club, interactive, critical thinking, active learning

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Introduction

Medical education has been issued a mandate to incorporate principles of active learning and adult education. Learner engagement with content, team-centered activities, and other key components of these pedagogies address the changes in medical students and physician roles while keeping pace with changes in educational trends.¹

Active learning incorporates instructional methods intentionally designed to invite learners to engage with, manipulate, and apply knowledge with integrated feedback and self-assessment.² Active learning activities increase the relevance of content and encourage the connection and integration of the new learning to existing knowledge. Engagement with the content allows a deepening of the learning. Team-centered activities and related interactive methodologies allow for the sharing of different perspectives as well as reflection of each participant's understanding and progress.^{2,3} Adult education has at its core active participation in relevant applications of content. It stresses strong connections between classroom activities and meaningful real-world applications, focus on problems and solutions, and respect for the learners' experiences and history within a collaborative learning environment of mutual trust, respect, and self-direction.^{4,5}

Initially, the mandate to incorporate adult education and active learning in medical education was addressed with minimal changes to the classic lecture format. Faculty added reflective pauses to lectures, incorporated new technology to gather immediate feedback from students during lectures, posed content-related questions during lectures, and even replaced some traditional lecture time with alternative teaching methodologies including team-based learning, problem-based learning (PBL), and case-based learning.² These initial adaptations are

significant in their attempt to redirect decades of tradition and go beyond the passive learning lecture format; however, they still leave significant room for advancing the application of the principles of adult education and active learning across medical education to enhance effective learning.

Existing alternative methodologies, including journal club, have been used as attempts to enhance active, adult, and lifelong learning. Journal club has been a traditional part of graduate medical education, and to a lesser extent, undergraduate medical education, and part of the training of most physicians and medical educators.^{6,7} Its history and persistent presence speak to the value of shared discussion of relevant research. Journal club traditionally includes many essential components of adult education and active learning, relevant content, opportunity for discussion, and learner direction. It provides a venue for presentation of new information, critical review of data, and evaluation of its credibility and applicability. The discussion can serve to maintain currency in rapidly evolving fields, to highlight research findings relevant to coursework or to reinforce evidence-based medicine skills and relevance. The importance of these factors has helped journal club maintain its place in medical education.

Although the classic journal club appears to have all the components needed for an active, adult learning experience, the result bears more resemblance to a traditional lecture. As in a lecture, one individual is tasked with reading and presenting an article to the group in a seminar-like format. As such, this type of journal club often becomes a passive learning experience for all but the individual presenting the journal article. All too often, the potential benefit, even to the presenter, is limited due to their paraphrasing the author rather than analyzing the



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article and its findings. The traditional approach may provide opportunities for discussion and participant involvement, however, they are discouraged by the format. Different approaches to journal club have evolved to encourage individual engagement and participation, but they usually remain very close to the classic approach and retain its shortfalls.⁸ Although journal club has the potential to be a productive, interactive, and even enjoyable experience, many see it as an obligation with little participant engagement or personal growth potential.

Interactive journal club is designed to meld the benefits of the traditional journal club presentation of relevant research with a new approach to reviewing the research that has as its goal an engaged, participatory, applied, and enjoyable experience in medical education. Participants are actively involved in a structured critical analysis of the data from relevant journal articles rather than passively listening to a peer's report of the author's writings. This revision of the traditional journal club uses critical elements of active and adult learning to maximize the participant's opportunity to develop critical thinking, communication skills, active reflection, and personal confidence in these skills.²⁻⁴ Unlike many new teaching approaches, implementation of the interactive journal club does not require significant training in the approach or extensive revision and preparation of course materials.

The Process

Interactive journal club differs from more traditional journal clubs in a number of significant ways. It provides a structured approach for discussing relevant articles (Table 1) which directs participants to process information, share interpretations with peers, reflect on the information's relevance, and reflect on their own knowledge and gaps of understanding. The journal article to be discussed can be chosen by a course director to highlight a component of the course or by a member of the group based on a shared interest (eg, departmental journal club). The article should be interesting and relevant to the group with well-presented figures and tables.

Each session requires a Designated Leader (DL). The DL can be a faculty member, resident, or student who is tasked with reading the article and preparing the materials for the structured process that is used in the interactive journal club. The DL prepares a series of slides containing the title and the data from the article and a set of slides with key process steps and questions that direct the session. It is often helpful, but not essential, for the DL to have enough familiarity with the field to be able to answer questions regarding background knowledge and investigative techniques.

Presentation of the article is significantly different from the traditional presentation. Participants, other than the DL, do not read the article in advance. The DL guides the group's analysis and discussion rather than providing a seminar based on the article, as in a traditional journal club. Specific instructions and key questions are used by the DL to guide the participants in

Table 1. Steps of the IJC.

PREPARATION STEPS
<ul style="list-style-type: none"> • Select topic • Identify DL • Select journal article (either by Director or DL) • DL reads and reviews journal article • DL prepares slides for each step in the IJC process: <ul style="list-style-type: none"> • Slide of journal article title • IJC procedure slides • Slide of each figure in the journal article including legend • DL may share the subject or title but not the text of the article. Participants do not read the article ahead of time
PRESENTATION STEPS
<ul style="list-style-type: none"> • DL orients the group and presents first procedural slide—analysis of the title • DL presents a slide of the journal article title and authors • DL facilitates discussion of title based on the analysis of the title slide • DL presents procedural slide of analysis of the data • DL presents slide of first figure from the journal article • DL facilitates discussion of the figure based on the analysis of the data slide • DL repeats procedure for each figure and table of the journal article • DL presents procedural summary slide • DL revisits title to facilitate final analysis and discussion

Abbreviations: DL, Designated Leader; IJC, interactive journal club.

the method that forms the basis of the interactive journal club approach. The key components of the article, beginning with the title, are presented separately on individual slides or hand-outs. Focus on key aspects of the title and each set of data (figures and tables) is enhanced by presenting each set of information on its own slide. Data figures (with legend) and tables are presented without the author's explanations but with sufficient supporting information, such as definitions or methods, to allow participants to provide their own analysis and explanations of the raw data. The DL directs the group's analysis of the title and data using key questions which are presented to the group on slides (Figures 1, 2, and 4) to guide the thought process and help focus and direct the subsequent discussion.

The DL begins the discussion by directing an analysis of the title which is presented on a slide with the names of the authors and citation. The title of an article should define the questions that were asked and answered and conclusions from the study. Proper analysis of the title, therefore, is a critical first step in the interactive journal club. The DL uses focused questions (Figure 1) to direct a step-by-step analysis of the title and group discussion of the article's intent and prediction of its content. First, the DL asks several participants to each restate the title in their own words (Figure 1, item 1) and to determine the questions that are being addressed in the article (Figure 1, item 2). Once the group has determined the article's intent and their expectations of the content, the DL turns the group's attention to how the article should fulfill the intent and facilitates discussion on approaches or experiments that the group would expect the author to have performed and included in the article (Figure 1, item 3). In this way, participants essentially put themselves in

ANALYSIS OF THE TITLE

1. RESTATE THE TITLE IN YOUR OWN WORDS.
2. WHAT DO THE AUTHORS CLAIM THAT THEY WILL DEMONSTRATE IN THEIR STUDY?
3. WHAT DO THEY HAVE TO PROVE TO YOU?
4. HOW WOULD YOU DESIGN THIS STUDY? WHAT TESTS/EXPERIMENTS WOULD YOU USE IF YOU WERE PERFORMING THE STUDY?

Figure 1. Presentation slide to guide the analysis of the title of the article. After introducing the journal club with a slide containing the title, authors, and citation, this slide can be presented and then referenced by the Designated Leader on reshowing the title slide. Alternatively, after the initial title slide, each element of this slide can be appended to the title slide to focus the discussion.

ANALYSIS OF THE DATA

1. DESCRIBE THE FIGURE AS IF TO A BLIND PERSON, VERBALLY RECREATE THE FIGURE ONE DATA SET AT A TIME.
2. RELATE (COMPARE/CONTRAST) THE DATA SETS OR PARAMETERS WITHIN EACH GRAPH, PANEL AND THEN WITHIN THE FIGURE.
3. DISCUSS THE FINDINGS AND THEIR MEANING:
 - A. EXPERIMENTAL METHOD
 - B. SCIENTIFIC FINDINGS
 - C. RELEVANCE AND VERACITY
4. RELATE THE FINDINGS TO PREVIOUS FIGURES.
5. WHAT WOULD YOU DO NEXT?

Figure 2. Presentation slide to guide the analysis of each of the figures and tables in the article. Question 5 is possible due to the progressive disclosure of the data within the interactive journal club format.

the author's shoes and, as a group, develop a research plan to address the questions they raised from the article's title (Figure 1, item 4). The questions used by the DL to discuss the title are designed to focus critical thinking on the author's goals, intent, and process and to provide an opportunity to apply problem solving and logic. The group's discussion forms the basis for critical evaluation of the merits of the article and its study. The questions within Figure 1 usually initiate an excellent discussion of experimental methods and research approaches as well as a list of expectations for the article. This list of expectations provides a framework for the subsequent review of the article.

The raw data, as presented in the figures and tables, are the focus of the next step of the interactive journal club session. The DL guides the group's discussion using a slide with key questions and instructions for analysis of the raw data (Figure 2). The DL presents each figure and table from the article on its own slide for the group to discuss without the author's narrative.

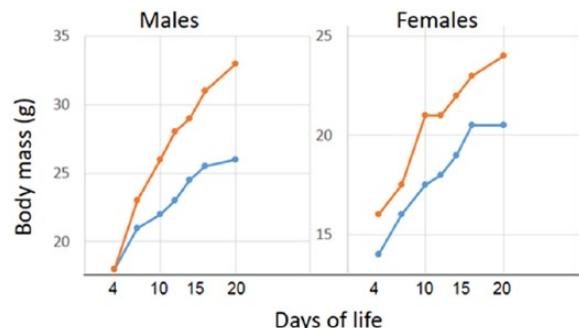


Figure 3. Example of a data figure. Data were redrawn and adapted from Vijay-Kumar, et al.⁹ This panel was 1 of 7 under the figure title, "T5KO (Toll-like receptor 5 knock out) mice develop obesity." Red lines reaching higher values represent knockout mutant, and blue lines with lower values represent wild-type mice. For this experiment, there were 10 males and 10 females.

Multicomponent figures should be broken into multiple slides with each panel component of the figure accompanied by the figure title and relevant legend description on the slide. If the author wrote the legend well, it should be sufficient to allow analysis of the data without reading the narrative text from the results section. Any special terms or abbreviations necessary to evaluate the figure should be added to the slide. Each participant is asked to review the raw data of each slide for themselves and critically reflect on the data before sharing their observations with the group. This step is designed to encourage review and analysis of the data and discourage overlooking or ignoring data that often results from applying a preconceived bias or premature conclusion. As each slide is introduced, the DL selects different group members to begin the analysis. The DL may initiate the discussion by presenting the first set of data, as an example. Because this is the first exposure to the data for all but the DL, the entire assembly is also reviewing and analyzing the figure for the first time.

The analysis of the data begins with development of a shared understanding of the content presented on each slide. First, the group member selected by the DL describes the data within the figure in concrete terms and without interpretation (Figure 2, item 1). The approach can be described as verbally recreating the picture. In the example in Figure 3 (redrawn from 1 of the 5 panels of graphs within a figure from the original),⁹ the description of the first graph for males can be presented as follows:

For males deficient in the TLR5 gene (knockout), their body mass starts on day 4 at 15 g and rises rapidly to 32 g by day 20, appearing to continue to increase, whereas the mass of normal mice also starts at 15 g on day 4, increases slower and levels off at 25.5 g by day 17, approaching a maximum of 26 by day 20.

This process would then be repeated for the data for female mice presented in the second graph within the panel before proceeding. In this way, the individual acts as though he or she is the eyes for someone who is not seeing the slide. Others in

SUMMARY

1. DID THE AUTHORS PROVE WHAT THEY CLAIMED IN THE TITLE?
2. IF YOU WERE TO SUMMARIZE THIS STUDY FOR A COLLEAGUE, WHAT ARE THE MAJOR LESSONS (LIMIT TO 3) LEARNED FROM THIS ARTICLE? THE TAKE-HOME LESSONS.
3. WHAT WOULD YOU HAVE DONE DIFFERENTLY?
4. WHAT ARE THE IMPLICATIONS TO THE DISCIPLINE (HUMAN DISEASE)?
5. HOW MIGHT THESE RESULTS INFLUENCE CHOICES FOR DIAGNOSIS OR TREATMENT OF HUMAN DISEASE?

Figure 4. Presentation slide to guide summation of the article. These questions revisit the initial discussion of the title to use as a guide for the article's evaluation and summary. Determination of "take-home lessons" promotes memory of the study.

the group are encouraged to add their descriptions or question the group about the description.

Next, the DL asks group members to relate the data sets within the graph or panel. In this example, the responses of normal and knockout males are compared first and then the responses of males are compared with females. As item 3 in Figure 2 details, the experimental method and the meaning and relevance of the data within the figure panel are the next critical foci for group discussion. Participants attend to the strength of the research methodology, noting any concerns regarding the veracity of the approach. In this example (Figure 3), questions of whether sufficient numbers of mice used in the experiment or length of observation period could be raised. For figures that comprise several panels of graphs or pictures that address a shared question, each component is presented and discussed separately, and then the discussion broadens to the figure as a whole.

Next, data from the figure are related to previously discussed figures from the article, and finally, it is related to data and findings from the literature (Figure 2, item 4). Prior to disclosing the next figure, the DL asks for predictions or expectations of the next experiment (Figure 2, item 5). Using progressive disclosure of the figures from the article, the participant has the opportunity to create their own logical experimental progression to answer the questions raised during the initial analysis of the title. On moving to the next figure, the group can compare their approach with that of the authors.

The group process encourages asking and answering questions by individuals to ensure understanding. Questions that arise regarding methodology, presentation, and interpretation of the data provide additional opportunities for discussion. If questions cannot be addressed by the DL, they can become learning opportunities for the group (similar to a PBL

approach). In larger group settings, "clicker" audience participation questions can be inserted to promote individual participation and personal evaluation of both the article content and competence with the process.

Once the review and discussion of all the figures in the article is complete, it is important for the DL to direct the group in a summary of the discussion, as guided by the questions in Figure 4. Because the group has thoroughly examined the data firsthand, provided critical review of the information and discussed the implications of the information without the author's interpretation or emphasis, they are able to provide an independent review of the study which is based on their own analysis of the presented evidence. The focus returns to the title of the article (Figure 4, question 1). The DL asks the group to remember the initial review of the title and consider whether the author provided sufficient proof to support the claims made by the title. The other summary questions identify the "take-home lessons" from the study and help the participants determine the relevance of the study to the discipline and to their own interests. The DL may also present a comparison of the group's conclusions to those of the author's.

Each journal club is presented with the same format. The process used to analyze the article, coupled with the DL's explicit review of the process each time, reinforces the application of critical analysis and reflection. As experience in the process increases, so does participation and voluntary involvement.

Discussion

The interactive journal club provides a straightforward, easily mastered system for review of a journal article which promotes active participation and directed discussion of scientific data in contrast to the prepared lecture-like presentation in a traditional journal club. Unlike the classical journal club, all attendees become involved in the review process, not just the presenter (Table 2). The interactive journal club stresses active participation rather than passive listening.

Discussion begins and ends with attention to the article's title to clarify the goals and outcomes of the study and its "take-home lesson." At the beginning, this provides the group with opportunity for critical thinking and problem solving. The step-by-step analysis and discussion of the data content by the participants allows them to determine the veracity of the information and draw their own conclusions rather than listen to the presenter's interpretation or read the textual editorial of the author that would limit and influence the analysis and conclusions. At the end of the session, by focusing the discussion around the title again, the group evaluates the author's success in reaching the goals suggested in the title and the value of the article to the group. Interactive journal club guides the group discussion and provides opportunity for each participant to evaluate the data, assess their own understanding of the content, and then determine their own relevant

meaning while interacting with others about the same content through a specific process of critical inquiry.

Participants purposefully engage in review of raw data and then apply previous learning about research and medical content to the analysis. The practice allows them to become more adept at study design, data analysis, and presentation. They reflect individually and as a group on the information discussed as well as their level of understanding of the content. The participants have the opportunity to watch others grapple with the content, challenge their own and each other's ideas, provide and receive feedback about interpretations and applications of the content, and create their own understanding of the concepts. Reflection on individual and shared understanding among learners enriches each learner's grasp of the content and their integration of the content with existing knowledge. The progressive, active learning of relevant content integral to the interactive journal club method strengthens its relevance and appeal to adult learners.

Facility with research design and data analysis has been identified as key to critical thinking and decision making.⁸ The interactive journal club experience provides opportunity to integrate information and provide effective use of feedback. A significant underpinning of the interactive approach is the explicit attention to thinking about both the content and analytic process during the activity. The DL makes the process explicit with slides of questions that guide the analysis. The process is repeated and remains consistent across interactive journal club sessions to provide a consistent framework for research and data review that can extend beyond the journal club. A consistent approach to data review and analysis that is used repeatedly over time has been identified as a key factor in both design and development of critical thinking and data-based decision making.⁸

Experience with the structured, data-driven, detailed approach of interactive journal club demonstrates the value of carefully looking at the data within the figures. In one session facilitated by the author, a medical student reviewing the graph shown in Figure 3 noted that the scale on the Y-axis for male and female mice was very different, and as a result, the presentation obscured the finding that the effect was much less pronounced in females than males. The initial focus on the content of the figures, without interpretation, encourages such attention to appropriate detail which is easily overlooked when the author's interpretations are parroted as in traditional journal club discussion. Oftentimes, the participants identify findings within the data that were relevant to the group but were not mentioned in the text by the author.

In several interactive journal clubs, the participants concluded that the article in fact did not prove what was described in the title. They found that some authors overstate their conclusions in their titles and some overstate or misrepresent the actual or implied applications of the results. Participants have identified limitations of the experimental or statistical

analysis, of the animal model, or of the nature of the patient population used in the research that compromise the validity or applicability of the study. By applying this high level of analysis, each participant determines the relevance and the utility of the article for themselves and develops better retention of the content. If participants' interest is piqued and they would like to further explore the article, they have the reference and can independently delve into the article in more depth.

Interactive journal club is flexible and can be adapted to groups differing in educational level and size while keeping the basic strengths of the approach consistent. This structured approach to critically reading and analyzing a journal article has been used with groups of graduate students, medical students, medical residents, and faculty. As such, the sessions were scheduled during 50-minute class periods or lunches. It can be applied in small or large groups whether meeting in small seminar rooms or large auditoriums. Interactive journal club was the approach of choice in research group meetings of 5 to 8 individuals on a biweekly basis. In the small format, a paper copy of the data from the article can be distributed. It has also been used successfully on multiple occasions within lecture-based medical school courses to emphasize the significance of new findings to auditorium classes of 70 to 230 learners. The study that was used as an example in this article was presented to classes of 250 medical and pharmacy students to allow them to integrate concepts in microbiology, immunology, and biochemistry as they worked through the research data and discovered the conclusions for themselves.

Participants have commented to the authors that this approach to journal club makes learning fun. The open, group participation, and interactive nature of this journal club decreased their reticence due to self-consciousness and encouraged participation. Others indicated to the authors that the interactive journal club provided a better approach to reading and reviewing the literature which they would adopt for themselves (Table 2).

Conclusions

Recent developments in medical education have shifted emphasis from a lecture-driven model to an interactive, adult education model of education to enhance the depth, relevance, and utility of medical learning. Interactive journal club provides a manageable adaptation of journal club which incorporates these principles and encourages critical thinking, analysis, reflection, and synthesis of information without the need for significant training of educators or extensive revision and preparation of materials. Adjusting the traditional journal club to an interactive model transforms a passive presentation of recent research into what has been described by participants as a lively, involved discussion which enhances exploration of recent research learnings and builds relevant skills. Interactive journal club allows the journal club

Table 2. Comparison of interactive and traditional journal club.

INTERACTIVE JOURNAL CLUB	TRADITIONAL JOURNAL CLUB
Session leader	
Designated Leader Guide discovery and analysis of article	Presenter Present seminar
Session leader tasks	
Select appropriate article Read article Prepare slides with procedure steps and copy title, figures, and tables (raw data) onto individual slides Guide attendee analysis and discussion of article	Select appropriate article Read article Prepare seminar that reports author's interpretations and summaries Prepare slides that paraphrase author's content, introduction, methods, figures and tables, discussion, and summary
Attendees' tasks	
Do not read article in advance Attend Analyze and discuss title and data Review and discuss data and outcomes for significance	Read article in advance Attend Listen to seminar Ask questions
Process	
Rephrase title to identify expected outcomes Propose experimental approach Analyze and discuss each figure and table Verbally describe data as if to a person outside of the room Provide personal independent interpretation Relate data within the figure to other figures and to knowledge base Review title to determine whether outcomes were reached	Listen to seminar
Outcomes	
Attendees are active participants	Attendees are passive audience

tradition to continue its important role in medical education, especially undergraduate medical education, while answering the call for new approaches to medical education.

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Author Contributions

KSR conceived and designed the experiments. KSR and JR contributed to the writing of the manuscript, agree with manuscript results and conclusions, jointly developed the structure and arguments for the paper, made critical revisions, and approved final version. All authors reviewed and approved the final manuscript.

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